RAILWAY MECHANICAL ENGINEER

With which is incorporated the RAILWAY ELECTRICAL ENGINEER

(Names Registered, U. S. Patent Office)

Founded in 1832 as the American Rail-Road Journal

MARCH, 1948

Volume 122 *No. 3*

Published monthly by

Simmons-Boardman Publishing Corporation

1309 Noble street, Philadelphia, Pa. Editorial and Executive Offices: 30 Church street, New York 7, and 105 West Adams street, Chicago 3. Branch offices: Terminal Tower, Cleveland 13; 1081 National Press bldg., Washington 4, D. C.; 1038 Henry bldg., Seattle 1, Wash.; 300 Montgomery street, Room 805-806, San Francisco 4, Calif.; 530 W. Sixth street, Los Angeles 14, Calif.; 2909 Maple avenue, Dallas 4, Tex.

The Railway Mechanical Engineer is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.) and is indexed by the Industrial Arts Index and also by the Engineering Index Service. PRINTED IN U. S. A.

Subscriptions, payable in advance and postage free, United States, U. S. possessions and Canada: 1 year, $3; 2 years, $5. Other countries in Western Hemisphere: 1 year, $5; 2 years, $8. All other countries: 1 year, $7; 2 years, $12. Single copies, 50 cents. Address H. E. McCandless, circulation manager, 30 Church street, New York 7.

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RAILWAY
MECHANICAL ENGINEER

Saving Weight in

A Diesel's Welded Underframe*

By Leonard Pompa†

The redesign and fabrication of a 2,000-hp. Diesel-electric locomotive underframe results in a 12,000-lb. weight saving

A LOCOMOTIVE builder had built a pilot model of a 2,000-hp. Diesel-electric locomotive with a welded underframe made up of structurals and plates which proved successful. However, the railroad on which this locomotive was placed in service was not subject to any code requirements. When this same type of locomotive was merchandised to another railroad subjected to code and axle-load limitations it was found to be too heavy. It was then necessary to find a way to reduce the over-all weight of the locomotive so that a prescribed maximum axle load could be met.

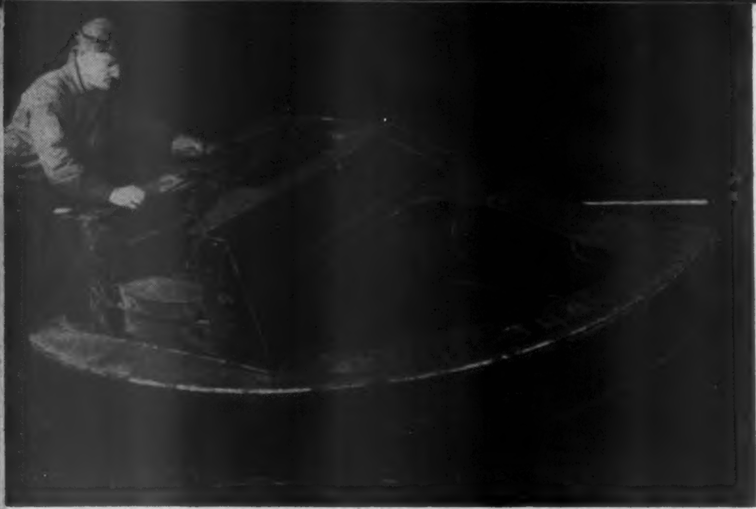
Since the weight of the engine and generator, the radiators, the fuel tanks and other auxiliaries are more or less fixed, the underframe was about the only major component where a reduction in weight could be realized. The author was commissioned to make a thorough study and a complete redesign of the underframe with a minimum weight reduction of 20 per cent as the objective.

The need for something other than the ordinary beam formulae was realized if full advantage was to be taken of the elastic property of every member. The theory upon which the analysis was based assumed the structure, made up of the under frame and side trusses, to

* An abstract of data and illustrations submitted to the James F. Lincoln Arc Welding Foundation for its recent $200,000 Design-For-Progress Award Program. This paper won the first award in the Railroad Classification.

† Development engineer. Lukenweld, Inc., Coatesville, Pa.

The nose and front bolster have been welded together to form one of the three main subassemblies



The nose of the frame with the draft-gear pocket

act as a rigid frame. This meant that all the loadings, or system of forces would act simultaneously and affect each member accordingly. The problem was then reduced to one of determining redundant forces acting at the intersections of the crossbearers and the panel points of the trusses. In the system of external forces acting on the structure the buffing and the drawbar loads or couples, as in this case, were taken into consideration. The solution of these redundant forces was obtained and summarized in terms of shear and moment diagrams, both for buffing and drawbar loads. These same forces, through the crossbearers and bolsters, were superimposed on the panel points of the trusses. Ultimately, the effects of all these forces were used in the determination of the deflection of the structure.

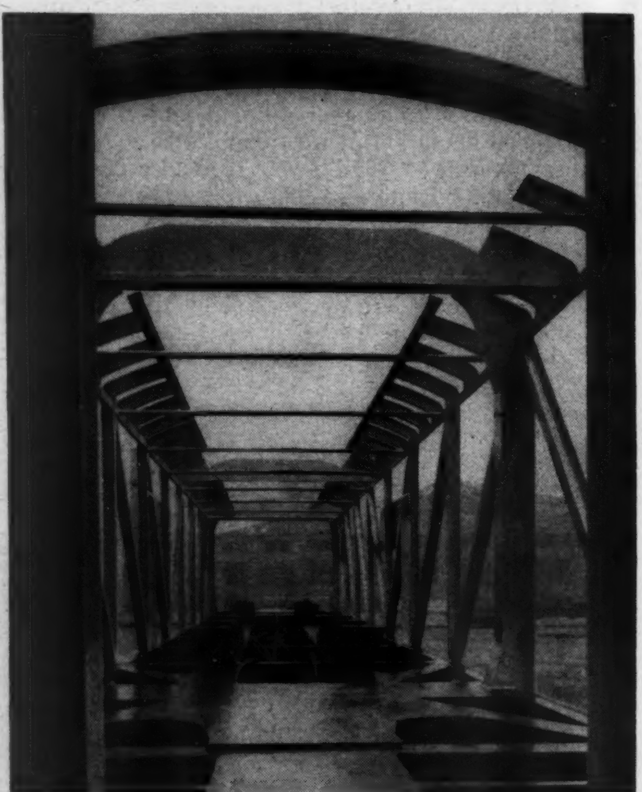
The most gratifying result from this analysis is the revelation that the moment due to the drawbar and buffing loads acting at the coupler housings does not affect the structure appreciably any farther than the bolster Consequently, this moment must be resisted and restricted within the space ahead or after the bolsters. This enabled us quickly to reduce the center-sill area to that primarily required by a direct compression load. Further, the engine bed or support, up to now assumed to carry no transverse load, was integrated into the center sill, and as a consequence of both of these deviations from standard methods of design, an appreciable reduction in weight was possible. Another revelation which these calculations brought out was the complete reversal of stresses in many component members. Consequently, fatigue consideration was required.

Welding Procedures

It has been our philosophy to make all welds, if at all possible, flat or position welds. In the application of this technique in the manufacture of these underframes, this idea was kept in mind at all times and the design was progressed accordingly. The subassembly work facilitated the handling of the parts during the assembling and welding operation but above all, it was possible to localize the unknown effect of shrinkage. All welds subjected to a reversal of stress or fatigue were given special consideration. For such welds the drawings specified full penetration, grinding smooth, etc.

A general welding procedure was adopted in order to obtain uniformity. The parent metal was 1020 carbon steel, and E6010, E6011, E6020, and E 6030 electrodes were used. The welding power supply was a. c. except for the E6010 electrode.

Few plates were rectangular and since these were secondary members, shearing was sufficient. However, the majority of the plates required chamfers and this was done by gas cutting. Some of the longitudinal members required planing in order to reduce the fit-up to a minimum, and some others required machined kerfs. The fit-up was kept to a maximum of $\frac{3}{32}$ in. for all fillets to insure the required leg size. About 80 per cent of all the fillets were $\frac{1}{4}$ in. A. W. S. accomplished by



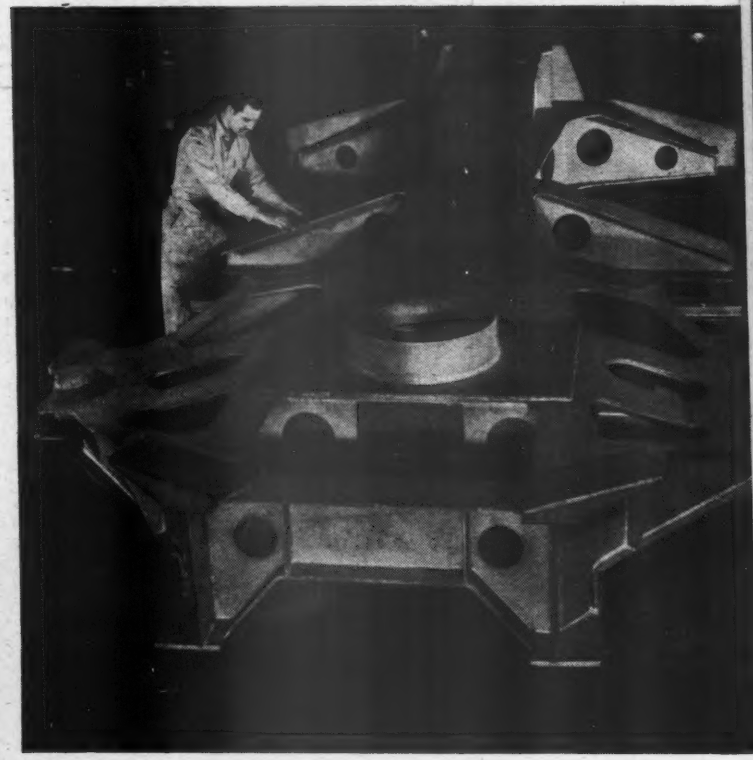
The old underframe

two passes. Other sizes were determined by the function of the welds and size of the plate.

All the main seams and critical joints and all the joints subjected to fatigue required full penetration welds. These were made by chamfering both sides of the plate, welding one side, chipping the root from the other side and welding up the groove. Afterwards the excess weld metal was removed and surface ground smooth. Before any welding was done all mill scale and other foreign material was removed. In the case of defects all the cracks and slag pockets were removed before subsequent welding.

Nondestructive tests were not required but some of the critical welds were Magnafluxed. No peening or partially welded buts were used. Before the three main sub-assemblies were put together the front and rear ends were stress relieved and grit blasted. It was believed that this operation was beneficial since in the process of welding many locked-up stresses were induced in the structure and by stress relieving these strains would be relaxed.

The back-end piece



Welded fabrication of the main back-end assembly resulted in a clean-looking design

The original frame weighed 38,000 lb. Upon the assignment of the problem to the author, a 20 per cent weight reduction was considered desirable if it could be realized. However, upon the completion of these underframes they were actually weighed and found to be 26,000 lb., showing a net weight saving of 12,000 lb., approximately 32 per cent of the weight of the original frame. In redesigning the truss, it was found that there was no possibility of reduction in weight over the previous design. However, the door opening was moved forward necessitating the replacement of a main member of the truss. This problem was solved by replacing the entire panel with a rigid frame panel of arc-welded steel plate. This method proved more desirable for it automatically provided a finished door opening.

Above: The body framing is partially installed on the new underframe; Below: completed underframe

Economics

It was not the question of economics that confronted the locomotion builder when the author was approached with the problem. It was mere necessity to reduce the weight as much as possible, lest the opportunity to sell the product be lost. In terms of dollars, however, the 12,000-lb. saving means, if we use a cost of 30 cents per pound for this type of work, that a saving of $3,600 was realized. This is an actual saving. If the hypothetical saving in terms of the horsepower used up to move useless locomotive weight could be diverted into pay loads, the author could probably go into a lengthly dissertation and come out with some astronomical figures representing savings due to weight reduction.

The Gas-Turbine Locomotive

Status of Locomotive Development Committee project — Principal problems have to do with coal - handling pulverization, and combustion — Full-scale combustion work now under way

NEW locomotives are needed today by railroads all over the world. The selection of the most advantageous locomotive type for a given service is complicated by the fact that all fuels have risen in price since the war, and serious doubt exists that liquid fuels will continue to be available at prices competitive with raw coal. Neither the United States nor the rest of the world need be without liquid or gaseous fuels or lubricants, for methods of synthesizing virtually any hydrocarbon are now well known. This knowledge, however, leads to certain conclusions concerning the future prices of liquid fuels. We in this country will always have any fuel for which we are willing to pay, but the price of all petroleum-based fuels will approach closer and closer to that of gasoline at the refinery.

Fuel Availability and Cost

The reason for this statement is relatively simple. Gasoline represents the largest single component of the demand for liquid fuels, and gasoline prices are established by the individual American automobile driver's ability to pay. To meet the almost insatiable demand for gasoline, the oil refineries have developed cracking processes which can convert increasing amounts of each barrel into distillate fuels, thus leaving less and less residual oil. Even that residue which is now left can be largely converted into gasoline by the process of adding more hydrogen to the hydrocarbon molecules.

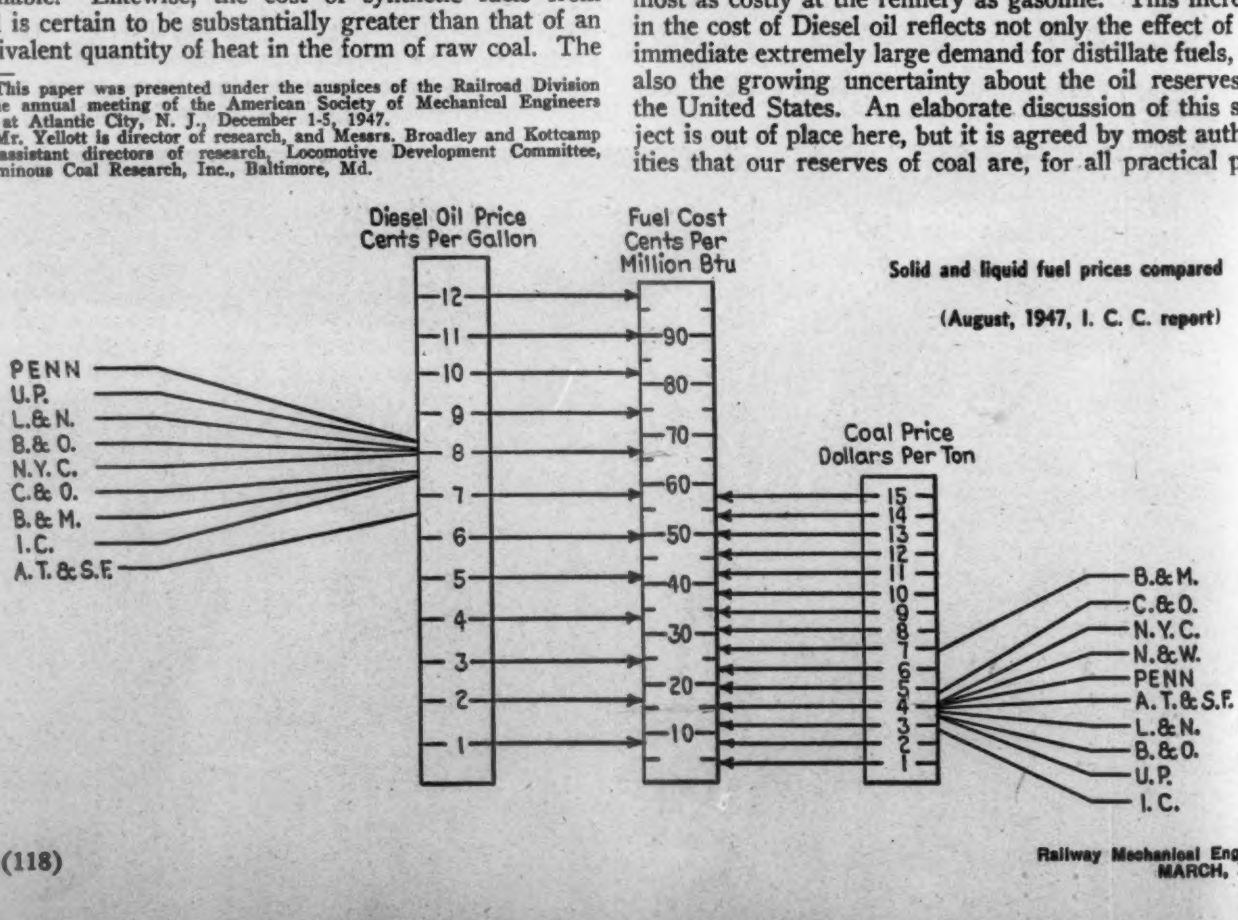
Synthetic gasoline and Diesel oil can now be made from natural gas and from coal, but the plants required to produce these fuels in large quantities will be expensive, and they will require tremendous quantities of steel. It is this latter factor which puts at least one time limit on the rapidity with which synthetic fuels can be made available. Likewise, the cost of synthetic fuels from coal is certain to be substantially greater than that of an equivalent quantity of heat in the form of raw coal. The term "raw coal" is used because it is very likely that one of the developments of the synthetic fuel program will involve processing to remove the hydrogen-rich volatile components which can readily be used for synthesis, while the remaining carbon is burned in pulverized form.

The prices being paid in August, 1947, for coal and Diesel oil by a number of American railroads are shown in the illustration. The common denominator, cents per million B. t. u., is also given, so that a comparison can be made between the values of coal and oil as sources of heat. Since most railroads do not pay freight for their own fuel, their coal costs approximated the price at the mine, which ranged between $3 and $5 per ton for railroads with on-line coal supplies. The value in terms of heat units at an average price of $4 per ton is approximately 16 cents per million B. t. u. The price of Diesel oil varied from a low of 6.5 cents per gallon to a high of about 8.3 cents per gallon, giving an average price somewhat below 8 cents, and a cost of about 65 cents per million B. t. u.

If Diesel fuel follows the prediction given above, it is likely that it will continue to rise in price until it is almost as costly at the refinery as gasoline. This increase in the cost of Diesel oil reflects not only the effect of the immediate extremely large demand for distillate fuels, but also the growing uncertainty about the oil reserves of the United States. An elaborate discussion of this subject is out of place here, but it is agreed by most authorities that our reserves of coal are, for all practical pur-

* This paper was presented under the auspices of the Railroad Division at the annual meeting of the American Society of Mechanical Engineers held at Atlantic City, N. J., December 1-5, 1947.

† Mr. Yellott is director of research, and Messrs. Broadley and Kottcamp are assistant directors of research, Locomotive Development Committee, Bituminous Coal Research, Inc., Baltimore, Md.



Solid and liquid fuel prices compared

(August, 1947, I. C. C. report)

poses, inexhaustible, while at the present rate of consumption, the oil now known to be in the ground will be exhausted before two decades have passed.

These trends in the availability and cost of the two principal locomotive fuels give added importance to the program of the Locomotive Development Committee of Bituminous Coal Research, Inc. Since May of 1945, the committee has been vigorously pushing the development of the coal-burning gas turbine. Several statements on the work of the committee have already been presented, and this paper will serve as a brief report on the present status of the program.

Coal Handling

The general principles of the coal-handling system are based on the assumption that the gas turbine must be able to burn any ordinary locomotive fuel without special wayside preparation. Drying, crushing, pressurizing, feeding and atomizing must all be accomplished as the fuel is needed. Preliminary size reduction and drying are accomplished as the coal is being fed from the bunker by the stoker. Waste hot air from the turbine exhaust is available in virtually unlimited quantities for circulating through the jacket around the stoker screw trough. Direct mixing of the hot air with the coal can be used if necessary, but this expedient will be used only for exceedingly wet coal, to eliminate the necessity of cleaning the drying air before it is vented. A magnetic pulley has been added to remove tramp iron before the coal enters the hammer mill, where it is reduced to minus eight mesh.

A mechanical elevator will carry the crushed coal to the inlet of the coal pump which transfers the fuel to the pressurized storage tank. Three types of coal pump are still under development, and the Standard Stoker Company has already built a double-acting piston type which can deliver 1,500 lb. of coal per hour against 150 lb. per sq. in. The supply of coal in the pressure tank is measured continuously by a level controller which starts and stops the stoker in response to the turbine's fuel requirements. The crusher, elevator, and coal pump will run continuously to avoid the necessity for equipment to start and stop them.

The feeding of coal to the turbine will be accomplished pneumatically, by delivering the crushed fuel from the tank at a fixed rate to a stream of air at 150 to 200 lb. per sq. in. The coal-air suspension passes from the feeder to a by-pass controller where the unneeded coal is returned to the tank. The coal required for combustion at any particular time passes on with the air through the atomizer to the combustors. Variation in coal quality can be overcome by changing the speed of the feed motor, thus varying the amount of coal fed at any setting of the by-pass controller.

Pulverization

The coal-handling system is now being tested with full-scale equipment, following successful operation of small-scale apparatus at the Dunkirk, N. Y., pilot plant. Principal difficulties encountered thus far are primarily related to pressurizing the coal and feeding it at the exact rate required by a gas turbine combustor. Coal, crushed to minus eight mesh and subjected to 200 lb. per sq. in., compacts itself into a very dense mass, and feed screws will deliver it satisfactorily only if continuous vibration or agitation is maintained.

Exceedingly fine pulverization appears to be necessary for successful combustion in the very limited time available in the combustion space on a locomotive. The air-operated coal atomizer has been developed for supplying coal to the burners of the gas turbine. Starting with the typical hammer-mill product which contains about 80 per cent plus 100 mesh, and 5 to 10 per cent minus 325 mesh, passage with compressed air through a convergent-divergent nozzle causes some pulverization to occur, primarily because of impact against the nozzle sides and collision among the particles. Addition of a target against which the fast-moving coal can impinge produces a product which begins to approach the design made after fundamental studies of the atomizer at Johns Hopkins University have resulted in a long nozzle, with a target directly in the line of flow, in which a pulverization of about 5 per cent of plus 100 and upwards of 80 per cent of minus 325 is produced with 1.35 lb. of air per lb. of coal and a pressure drop through the atomizer of 90 lb. per sq. in. Tests made at Dunkirk in 1946 showed that the atomizer could produce superfine material (0.5 per cent plus 100, 97.5 per cent minus 325) when enough air was used (4 lb. per lb. of coal), at a top temperature of 400 deg. F. Most of the work done since those tests was directed towards reducing the air-coal ratio to a more economical value, and eliminating the need for heating the atomizing air. The major remaining problems in the jet atomizer are the proper pulverization of coal of very low grindability (below 50 Hardgrove) and the development of a simple means of varying the throat area to accommodate changes in load.

Combustion

Full-scale work on combustion is now under way at Battelle Institute, at atmospheric pressure, and at the Northrop-Hendy Company's test site in the Kaiser Steel Works at Fontana, Cal. The gas turbine power plants will use two horizontal combustors, receiving their preheated air from the regenerator at 600 deg. to 700 deg. F., and discharging through a 180 deg. bend into the fly ash separator. The most successful combustors tried thus far have been very similar to those used in the turbo-jets and ram-jets, where cooling air is admitted through slots, holes, and scoops. A detailed report on the combustion work at Battelle is being presented at this meeting by Messrs. Hazard and Buckley, who conducted the work done for the committee at Battelle Institute.*

Small-scale combustors have been operated under both atmospheric and elevated pressures without encountering serious troubles from coke formation or slagging. Ignition is always accomplished with oil as a pilot flame, and, after the combustor has been heated up, the coal is turned on. Provision will be made on the locomotive to use oil as a standby fuel so that, in case of coal-handling trouble, the train can be brought in on oil. Train-heating steam will be provided by conventional boilers which will use the same oil supply. The locomotive will be started by the aid of a small Diesel-electric generator which will motorize one of the main generators for cranking the unit. Thus the oil which must be carried as a starting fuel will be used advantageously in a number of applications.

The Fly-Ash Problem

The products of combustion from the coal burners will always contain fly ash, which should be removed as completely as possible to prevent damage to the blades from abrasion by the coarse ash particles. Tests at the

* Experimental Combustion of Pulverized Coal at Atmospheric and Elevated Pressures, by H. R. Hazard, research engineer, fuels division, Battelle Memorial Institute, Columbus, Ohio, and F. D. Buckley, engineer, Locomotive Development Committee, Dunkirk, N. Y., presented under the auspices of the Fuels Division, at the annual meeting of the American Society of Mechanical Engineers, at Atlantic City, N. J., December 1-5, 1947.

Institute of Gas Technology showed that the removal of the larger components of the fly ash by the use of small mechanical separators rendered the combustion products virtually non-abrasive. Within the temperature range of the gas turbine, however, and at the velocities encountered in the turbine, there is evidence that the finer constituents of the fly ash will tend to adhere to the blades. The coating which was encountered in stationary test equipment was hard, smooth, and enamel-like, but it could be removed either, by sandblast or by chemical solution. Stress-rupture tests have shown that the coal ash coating is not harmful to the metal on which it is deposited. Maintenance of the coal-fired turbine is likely to consist of blade cleaning, rather than blade replacing.

The individual fly-ash separators, of the Aerotec design, will be mounted horizontally within a six-foot diameter steel shell. Stainless steel tubes and duct liners will be used, with internal insulation between the liners and the carbon-steel pressure shell. The major mechanical problems in the combustion and fly-ash separation system are those of thermal expansion. Adequate freedom must be given to the regenerator and turbine shell.

The fly ash will be removed from the separator by a slowly rotating worm which will discharge the ash through a simple crusher into an air line. The air will convey the ash through a pressure-reducing orifice to a storage tank, where the air will be vented through a series of small separators. The ash, cooled by mixing with relatively cold air, will be discharged at the locomotive's terminals. Tests of the fly-ash collection system in small units indicate that the cleaned combustion products will comply with the standard smoke ordinances.

The Gas Turbines

Gas turbines for the coal-burning power plant are now under construction by the Elliott Company and the Allis-Chalmers Company. The Elliott plant will use a two-stage centrifugal compressor delivering air at a maximum pressure of 55 lb. per sq. in., abs., through a regenerator to the combustion and fly-ash removal system. Maximum temperature at the turbine inlet will be 1,250 deg. F. A single, double-ended d. c. generator will be driven from the main shaft through a reduction gear. An alternator for supplying auxiliary power will be combined with the main generator, while d. c. auxiliary generators and exciters will be mounted above the main generator. The booster compressor, for supplying the atomizing air, will be driven by the generator shaft. Governing will be accomplished by both temperature and speed variation, to give good efficiency over a wide range of loads. The Elliott plant is very similar to that which will be installed in an oil-burning gas-turbine locomotive now being built for the Santa Fe by the Baldwin Locomotive Works.

The Allis-Chalmers unit consists of a 21-stage axial compressor discharging through a regenerator at a maximum pressure of 75 lb. per sq. in., abs., to the combustion and fly-ash separation system. The higher pressure will enable the fly-ash separator to be somewhat smaller than that for the Elliott unit. The Allis-Chalmers plant will use four 1,000-hp. d. c. generators, driven through a reduction gear. Auxiliary a. c. and d. c. generators, exciters, and booster compressor will be mounted above the generators and driven by auxiliary shafts from the main reduction gear.

It is planned to conduct extensive tests on these turbines at the manufacturers' plants with both oil and coal firing, and to install them in locomotives as soon as satisfactory operation is obtained.

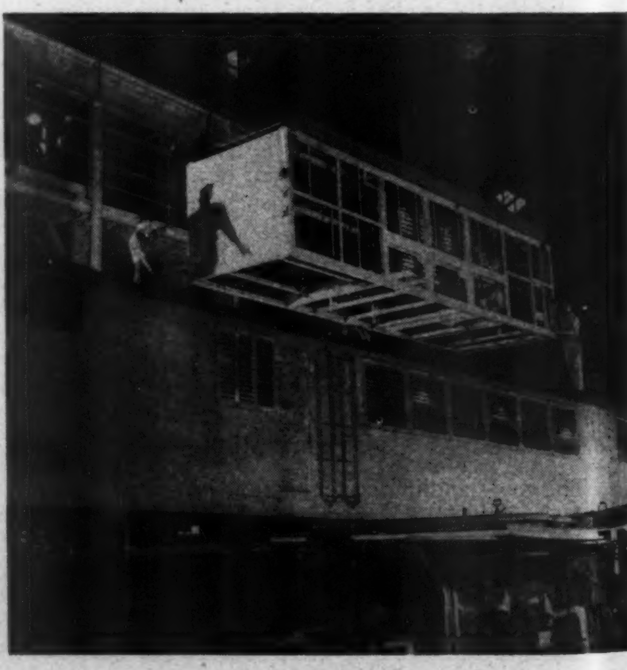
Experimental Locomotives

Preliminary engineering is now being done on two experimental locomotives. The American Locomotive Company is designing a power unit to house the Allis-Chalmers plant, while the Baldwin Locomotive Works is concentrating on the Elliott unit. Two units will be used in each case, with operator's cabs provided at each end, so that the necessity for turning the locomotive will be eliminated. The ordinary designation of A and B units is not applicable, because the trucks on both units will be motorized, the center axle being idle in each case. Six-wheel trucks, identical to those now used on Diesel-electric locomotives, will be employed, so that interchangeability can be obtained, and maintenance facilities now available can be used.

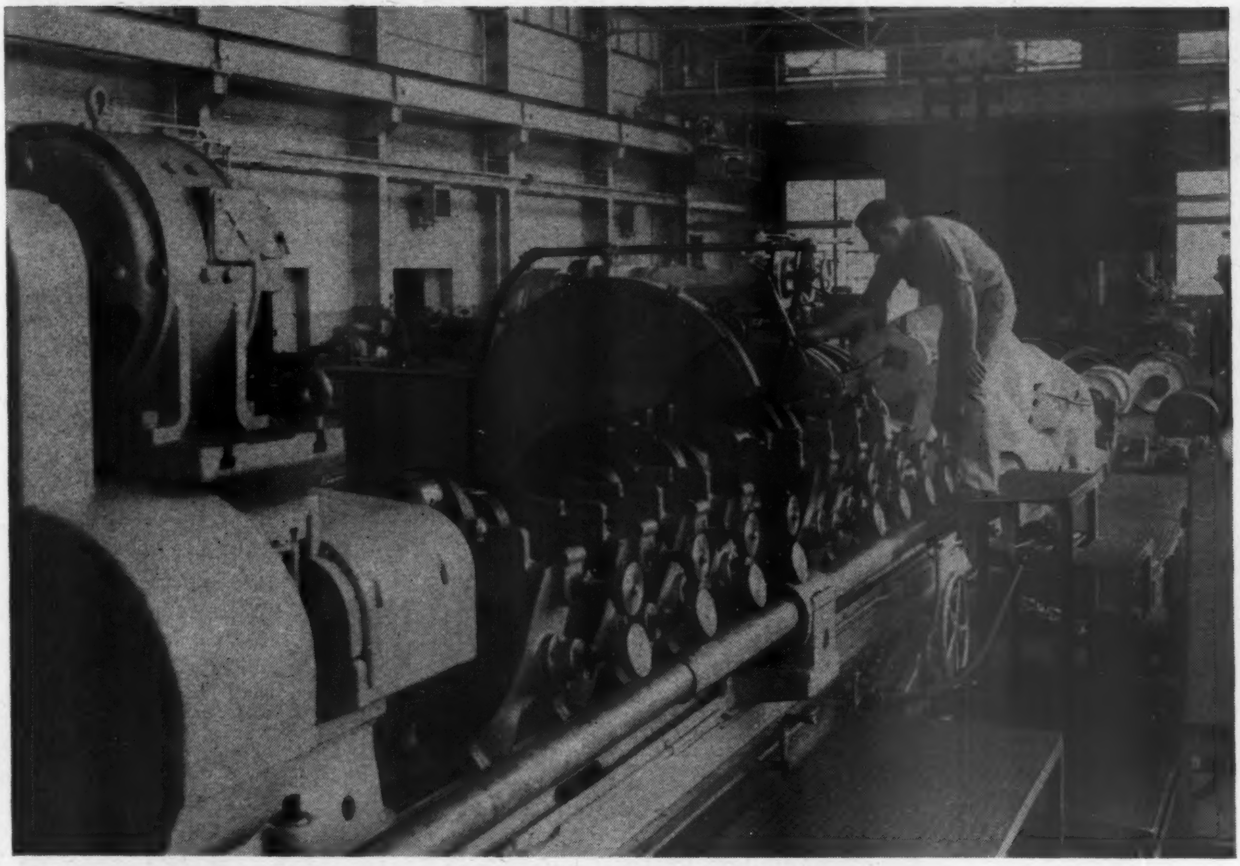
The coal-handling equipment, train-heat boilers, starting Diesel, and air-brake compressor will be contained in the auxiliary unit. Weight distribution is such that the axle loading will not exceed 60,000 lb. It is anticipated that the locomotives will be able to carry from 17 to 20 tons of coal, approximately 4,000 gallons of water for the train-heat boilers, and about 1,500 gallons of Diesel oil. Full-load fuel consumption will be in the vicinity of one pound of 13,000-B. t. u. coal per rail hp.-hr.

The Baldwin-Elliott locomotive is conservatively rated at 3,750 turbine shaft horsepower, with a maximum speed of 100 miles an hour. The Alco-Allis unit has the same nominal rating but the turbine power is likely to exceed 4,000 hp. Present plans call for the design of the power unit to be carried as far as necessary to enable the turbines to be completed at the earliest possible moment. When coal firing tests at the turbine builders' plants have progressed to an appropriate point, the designing of the locomotives will be completed, and they will be constructed as rapidly as possible. It is hoped that at least one unit can be on test during 1948.

* * *



Two overhead cranes at the East Pittsburgh Works of the Westinghouse Electric Corporation work in unison as the 32,000-lb. control assembly is lowered into the cab of a 4,000-hp., 3,000-volt d.c. electric locomotive destined for service on the Central Railways of Brazil—Once in the cab, the special I-beam lifting frame is unbolted and the steel structure enclosing the control components welded into place—Side and top panels are later bolted into place to protect the electrical equipment



Operator using Foster gauge to check main bearings on large Diesel crankshaft in Landis grinder

Chicago, Burlington & Quincy

Diesel Crankshaft Repairs

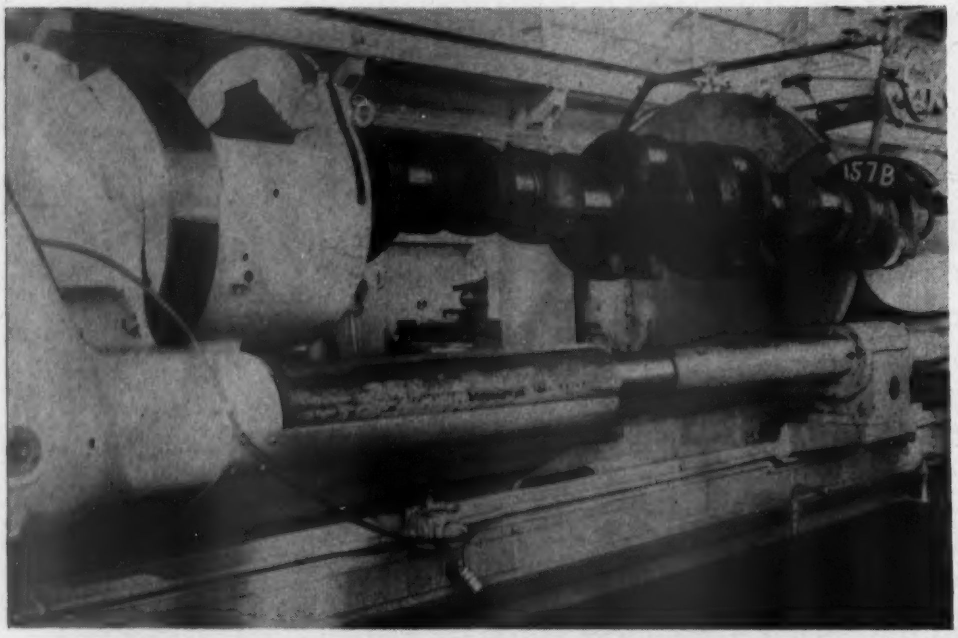
The combination crankshaft- and axle-grinding machine* installed at the West Burlington, Iowa, Diesel shop of the Chicago, Burlington & Quincy, is an effective tool for controlling maintenance costs and Diesel locomotive performance and availability on the Burlington. The machine, made by the Landis Machine Company, Waynesboro, Pa., is large enough to grind E-M 567, 16-cylinder, 2-piece crankshafts without unbolting at the middle connection. The machine will swing work 40 in. in diameter by 200 in. long and for some operations uses a 54-in. grinding wheel with a 4-in. face. It weighs 114,000 lb.; is mounted on an 82-cu.-yd. reinforced-concrete foundation, sand filled, which is thoroughly insulated from shop building vibration. It represents an investment of $87,000, installed.

As shown in one of the tables, the crankshaft grinder output in 1947 included 31 crankshafts, of which 15 were gas-electric and 16 were Diesel. In addition, 203 power-truck axles were ground, including 60 new and 143 second-hand. The grinder was operated one one shift only and therefore, has reserve capacity for increased grinding requirements.

A number of facts of interest have been developed as a result of Burlington experience with this machine in the last two years. As shown at the bottom of the table just mentioned, the Burlington has a total of 346 Diesel crankshafts in service and 22 spare; the passenger motor-car inventory is 34 in service and 3 spare. Some of the larger crankshafts now cost upwards of $5,000 each and the Burlington investment in Diesel crankshafts alone probably exceeds one million dollars, hence the need for safeguarding and securing maximum returns with this equipment.

In attempting to determine how frequently Diesel crankshafts need regrinding, a detailed study was made on the Burlington and indicated that the period between grindings on road Diesels varied from 1,000,000 to 1,750,000 miles and on switchers from 6 to 8 years. The lower limits in each case were selected as desirable points at which to take Diesel engines in the shop, completely disassemble, grind crankshafts and renew or recondition all parts. Broken crankshafts, of which there were three on the Burlington in 1947, have to be replaced immediately. Scored crankshafts, of which there were eight in 1947, are due usually to lubrication failures and must be ground at once regardless of the mileage. This is also done in the infrequent cases when bearings wear out-of-round, or undersize from .0025 to .0035 in. in less than 1,000,000 miles.

* This machine was described in the November, 1945, *Railway Mechanical Engineer*, page 549. For a description of the West Burlington Diesel shop see the *Railway Mechanical Engineer* for January, 1947, page 9.



A Diesel crankshaft being set up for grinding the crank bearings

Rack for holding grinding wheels — The static wheel-balancing device is shown in foreground

The general practice is to grind all main and crank bearings in $\frac{1}{32}$-in. step sizes to $\frac{1}{8}$ in. undersize, as recommended by individual manufacturers and shown in the second table. All main bearings are normally ground to one size and crank bearings to another, as specified in the table, but there are some exceptions to this rule. In case a single bearing has run hot and is badly cut or scored, this bearing, only, is ground to the nearest step size and the necessary correction made in the badge plate showing exact bearing sizes which is applied to each engine.

The Burlington utilizes metallizing to a limited extent in building up worn crankshaft bearings so they can be ground to standard size, but this practice is confined for the most part to Diesel switchers and passenger motor-car equipment. Satisfactory results from a performance standpoint have been secured with a few applications of the Bingham crankshaft sleeving process of rebuilding bearings to standard size on motor-car crankshafts.

How the Crankshaft Grinder Is Used

A number of important details have to be looked after before actual grinding begins. The first is selection of a grinding wheel of the correct grain, grade and size for the work at hand. On large Diesel crankshafts, the

Crankshafts and Axles Ground at West Burlington Diesel Shop in 1947

INTERNAL COMBUSTION CRANKSHAFTS

Type of Crankshaft	Number reground
P. M. C.# Model 120	10
P. M. C.# Model 148	4
Climax gas-electric	1
E-M 201-A, 12-cyl.	3
E-M 201-A, 16-cyl.	1
E-M 567, 12-cyl.	2
E-M 567, 16-cyl.	8
Baldwin, 8-cyl.	2
Total	31*

POWER TRUCK AXLES

Number ground new	60
Number reground	143
Total	203

CRANKSHAFTS OWNED BY THE C. B. & Q.

	In service	Spare	Total
Freight	104	4	108
Passenger	109	10	119
Switch	123	8	131
Gas-electric	34	3	37
	370	25	395†

#Passenger motor cars, gas-electric
* Includes 15 gas-electric and 16 Diesel crankshafts
† Includes 37 gas-electric and 358 Diesel crankshafts

Burlington uses an aluminum oxide A-46-H vitrified wheel 54 in. in diameter with 4-in. face. This wheel is accurately balanced by adjusting center weights while the wheel is supported on a static balancer shown in one of the illustrations. In this connection, the grinding wheel is spun for five minutes before shutting down at the end of each shift to throw off excess coolant fluid which would otherwise settle in the lower half of the porous wheel and make it out of balance when started again the next morning.

The grinding machine is checked to make sure that the work-head centers are accurately parallel with the ways of the machine and the grinding-wheel centerline. Steady rests are examined and, if necessary, new canvas strips applied over the cast-iron blocks which are used, Burlington experience indicating that this practice gives better results that hard-wood blocks, copper faced blocks, or hard bronze blocks, all of which, in varying degree, have a tendency to become imbedded with abrasive particles which mar the bearing surfaces.

Still another preliminary detail is accurate dressing of the grinding-wheel face parallel with the work centers and rounding the corners to the exact radius of fillets between the bearing and crankshaft cheek. This is done with an ingenious self-contained diamond dresser, built into the work carriage and designed to true the face of the wheel and accurately round the corners with the same diamond-tool cutting point.

A Foster gauge, made by the Foster Engineering Company, Royal Oak, Mich., is examined to see that it is in good working order for it has an important bearing on the accuracy and production rate of work done on the crankshaft grinder. This gauge is of the swing type, attached to the wheel housing and arranged with contact points to bear on the reduced diameter of work being ground. A micrometer indicator graduated in one-half thousandths gives instantaneous readings of bearing size and also indicates out-of-round, or chatter conditions.

Other gauges, in addition to conventional micrometer calipers, used in checking the accuracy of crankshaft grinding include a Starrett strain gauge with micrometer indicator to insert between individual bearing cheeks and tell when steady rests are properly adjusted; also another micrometer indicator suitably supported from the ways of the machine so it can be applied against the underside of any bearing and give a check of concentricity with other bearings—in other words test the alinement of bearings.

When a Diesel crankshaft is received at West Burlington shop, all bearings are calipered and the shaft is examined carefully for cracks on the Magnaflux machine, shown in one of the illustrations, using the wet Magna-

Watson-Stillman 125-ton hydraulic press used in straightening Diesel crankshafts

Rear view of the crankshaft grinder at West Burlington Diesel shop—P. M. C. crankshafts in the foreground

flux test method. For grinding main bearings, the shaft is set up between Neilson heavy-duty ball bearing centers in the machine, with steady rests applied to all bearings and adjusted until the Starrett strain gauge shows the same reading between bearing cheeks whether the adjacent crank bearings are up or down.

The main bearing with most wear is then positioned opposite the grinding wheel and a single plunge cut made to the next smaller step size, the diameter being held to shop limits of $+0$ and $-.001$ in. The reading of the Foster gauge is noted and a second plunge cut made to the same depth, as quickly and accurately indicated by the gauge. These two cuts generally finish the bearing and both fillets, but in the case of exceptionally wide bearings, three plunge cuts of the grinding wheel might be necessary.

An ample supply of coolant is directed on the bearing, primarily to keep it cool, but also to wash away abrasive and metal particles. The grinding-wheel speed is about 450 r.p.m. with a 54-in. wheel, or 6,500 surface ft. per min., the crankshaft being revolved at 15 to 32 r.p.m., as required to give 90 to 100 ft. per min. bearing surface speed. All main bearings are subsequently ground, in no particular order, and finished to the same size within .001 in. Taper is limited to .0005 in. The bearings must be not over .0005 in. out-of-round and concentric within .002 in. In case the main bearings are out of line more than .002 in., the shaft has to be straightened, as described later. About four hours are required to set up a large Diesel crankshaft in the machine and one hour to grind each main bearing.

For grinding crank bearings, the shaft is set up with the end main bearings in properly offset throw blocks in the workheads. Two steady rests are applied on four-cycle shafts and one steady rest on two-cycle shafts. Counterbalance weights in the driving heads are adjusted until ammeters on the instrument panel show equal and constant current input to the two synchronized driving motors. The bearings in line with the work centers are ground by the same procedure described, the steady rests removed, holding blocks loosened and the shaft revolved for grinding the other crank bearings, either one or two at the same setting. With exceptionally long shafts, the eccentric steady rest referred to must be used on one of the intermediate main bearings.

The same tolerances and limits of accuracy are used

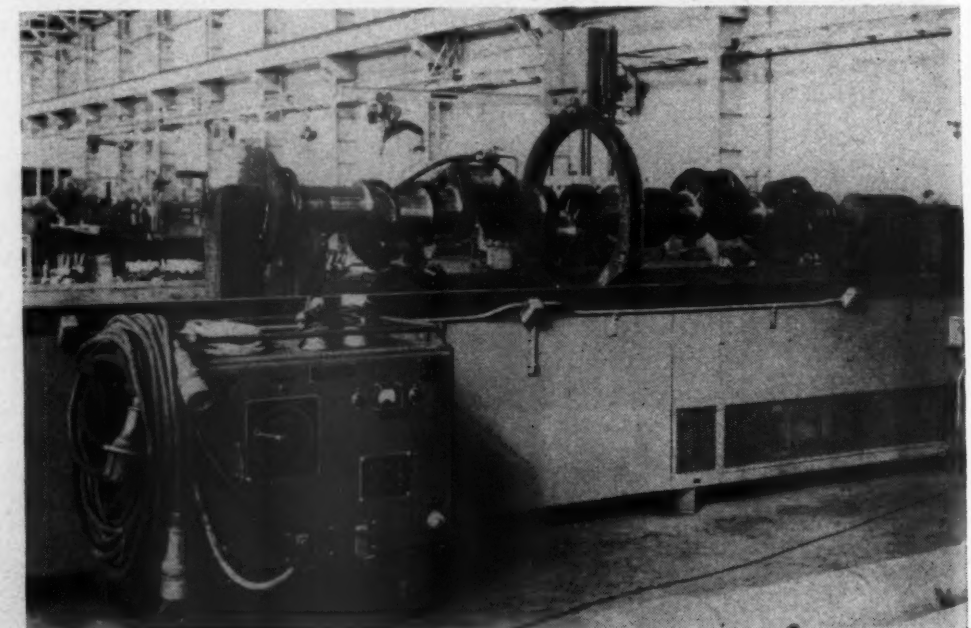
	Standard	Undersizes				Limit
		P. M. C. Model 120 — Throw 4.250				
Mains,	4.000	No definite undersizes				3.8125
Cranks,	4.000	Grind all to same size				3.8125
		P. M. C. Model 148 — Throw 5.000				
Mains,	4.500	No definite undersizes				4.3125
Cranks,	4.500	Grind all to same size				4.3125
		Cummins Model L — Throw 5.000				
Mains,	5.500	5.490	5.480	5.470		5.460
Cranks,	4.250	4.240	4.230	4.220		4.210
		E-M 201A — 8, 12 or 16 cyl. — Throw 5.000				
Mains,	6.7495	6.71825	6.687	6.65575	6.6245	6.59325
Cranks,	5.9995	5.96825	5.937	5.90575	5.8745	5.84325
		E-M 567 — 6, 12 or 16 cyl. — Throw 5.000				
Mains,	7.4995	7.46825	7.437	7.40575		7.3745
Cranks,	6.4995	6.46825	6.437	6.40575		6.3745
		Baldwin 8 cyl. — Throw 7.750				
Mains,	8.747	8.71575	8.6845	8.65325		8.622
Cranks,	8.372	8.34075	8.3095	8.27825		8.247
		Alco — Throw 6.500				
Mains,	9.500	9.490	9.460	9.415		9.375
Cranks,	8.250	8.240	8.225	8.200	8.175	8.125

as in the case of main bearings. About four hours are required to change over from grinding main to crank bearings and, on account of additional adjustments, the total time taken in grinding one crank bearing is increased to about 1½ hr. In the case of an E-M 567, 16-cylinder engine, with nine main and eight crank bearings, therefore, the set-up and grinding time averages 13 hr. for main bearings and 16 hr. for crank bearings or a total of 29 hr.

In spite of all precautions, steady rests leave a slight discoloration on crankshaft bearings and, after grinding, all bearings are polished with a fine abrasive cloth and oil and finished with jeweller's rouge in a leather holder. The resultant high degree of finish, in conjunction with extremely accurate step sizing, permits subsequent application of accurately made main-bearing shells and connecting-rod bearing shells without any hand scraping or fitting.

How the Straightening Press Is Used

Referring back to the question of concentricity of bearings, a large Diesel crankshaft when supported at the ends may sag from .060 in. to .070 in. at the center due



How Diesel and other crankshafts are tested in Magnaflux machine by the wet method

to its own weight. With a support at the center to correct this sag, all main bearings are required to revolve with less than .002 in. difference in reading of a micrometer indicator applied in connection with a surface gauge underneath each bearing.

In case this concentricity test is not met, the crankshaft requires straightening which is done cold on a Watson-Stillman 125-ton hydraulic press, usually before the crank shaft is set-up in the grinding machine. This press, recently installed, is made of two 20-in. I-beams, 18 ft. long, suitably supported on short legs at each end and equipped with upper and lower cross pressure bars connected by two 4½-in. vertical rods and nuts. This assembly which carries the hydraulic ram in the upper head is normally supported and movable along the I-beams.

A small oil pump, control valves, oil-circulating system and pressure-indicating gauge are installed on the opposite side of the press to that illustrated and give flexible control for easily graduating on or off any desired pressure up to 125 tons. A Diesel or other crankshaft brought to this press for straightening is inserted under the pressure and the main bearing at each end supported on rollers which permit free rotation of the shaft in checking straightness. The ram is positioned as required, and two strong adjustable V-blocks are brought up high enough under any pair of main bearings to take the load off the rollers. Hydraulic pressure is applied in steps and the shaft deflection carried enough past the neutral axis so that when pressure is released the shaft will spring back with all main bearings in a straight line.

In one case of a Diesel crankshaft which was sprung .109 in. out of line due to heating in service, a pressure of 16 tons and total deflection of .625 in. was required for the shaft to spring back straight. The shaft shown in the illustration is sprung .253 in. and obviously will require still more tonnage and deflection, particularly as it is an unusually large shaft. These shafts are straightened cold during manufacture and, owing to the ductility of the material there are no reported instances of subsequent failure due to cold bending, at least on the Burlington. One important precaution, to avoid damaging the bearings, is to use copper facing on the V-blocks and a copper thrust block under the ram.

There is no machine which can be used for dynamic balancing of Diesel crankshafts at West Burlington shop. Crankshafts are equipped with counterweights in accordance with manufacturers specifications and, in Burlington experience over a number of years there have been only two instances when excessive engine vibration was traced to the crankshafts, which had to be sent back to the manufacturer for rebalancing.

No highly specialized skill is required to operate the crankshaft grinding machine in refinishing Diesel crankshaft bearings. Any qualified machinist with reasonable diligence and care can learn the fundamentals under competent supervision and do routine work inside of two weeks. Six months experience will place him in a better position to know what must be done under various unusual conditions and the operator will, of course, never reach a time when there is not something new to be learned about the machine and its use.

Grinding Power-Truck Axles

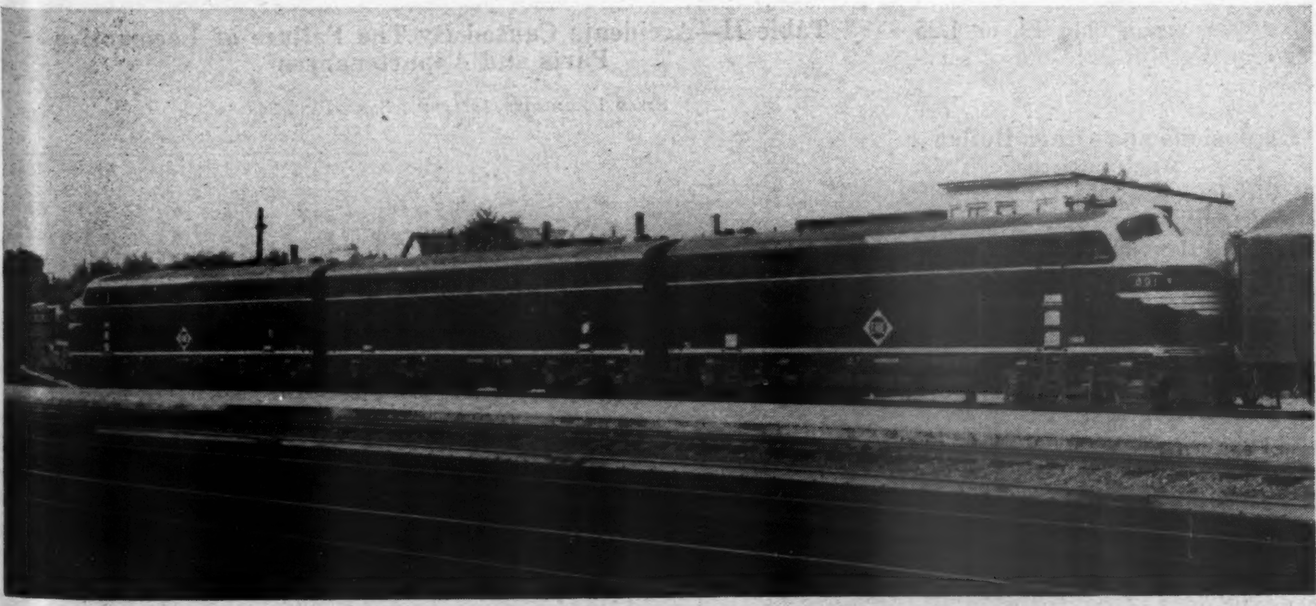
The crankshaft grinder at West Burlington shop is also used for grinding power-truck axles and this practice will be continued until enough Diesel crankshafts require regrinding to utilize the full time of the machine on one or more shifts.

All power-truck axles are ground all over except for the gear and wheel seats, particular attention being paid to grinding large and smooth fillets. New axles are turned with .025 to .030 in. allowance on the diameter for grinding.

The practice is to grind axles in groups in order to avoid frequent changes of grinding wheels which takes about 35 min. The advantage of this is indicated by the fact that it takes about 5½ hr. to set up the grinder, change wheels and grind a single new axle. A group of new axles can be ground in an average time of 3 hr. each.

The axles are supported between ball-bearing centers in the grinding machine and driven by arm or dog connection to the face plate. With a grinding wheel of the correct grain, grade and size, axles are ground by traversing the axle past the grinding wheel. A good commercial finish is secured and no further treatment required before putting the axles in service. A particular advantage of the large crankshaft grinder for this job is that axles may be ground, if necessary without removing the wheels.

* * *



A 4,500-hp. E.M.D. Diesel-electric locomotive in passenger service on the Erie

Locomotive Inspection Report

Inspections of steam locomotives decrease due to declining number in service—Boiler explosions account for the loss of 11 lives during year

For the first time in several years the number of steam locomotives for which reports were filed and the number of steam locomotives inspected have taken a decided drop while at the same time the number of locomotives in the category "other than steam" show continuing increases. This is one of the reflections of the gradual change that is taking place in the character of motive power on United States railroads as shown by the thirty-sixth annual report of the Bureau of Locomotive Inspection for the fiscal year ended June 30, 1947, recently issued by Director John M. Hall.

A total of 107,149 inspections were made during the fiscal year as compared with a total of 112,777 in the previous year. The percentage of steam locomotives found defective remained at 11 and in the case of locomotives other than steam the percentage was 4.8, a decrease of 0.2 per cent from the previous year. Of the steam locomotives inspected 708, or 7.5 per cent were ordered out of service and in the case of locomotives other than steam only 19, or 1.25 per cent, were ordered out of service.

Table I—The Number of Locomotives In Service, The Number Inspected and the Conditions Found

STEAM LOCOMOTIVES

	Year ended June 30—					
	1947	1946	1945	1944	1943	1942
Number of locomotives for which reports were filed	39,578	41,851	43,019	43,297	43,064	42,951
Number inspected	94,034	101,869	115,979	117,334	116,647	113,451
Number found defective	10,248	11,337	11,975	12,710	11,901	10,970
Percentage inspected found defective	11	11	10	11	10	10
Number ordered out of service	708	690	506	630	487	474
Number of defects found	41,250	56,541	53,367	56,617	51,350	44,928

LOCOMOTIVES OTHER THAN STEAM

	Year ended June 30—					
	1947	1946	1945	1944	1943	1942
Number of locomotive units for which reports were filed	7,805	6,616	6,094	5,139	4,351	3,957
Number inspected	13,115	10,908	9,888	7,711	6,847	6,728
Number found defective	633	499	447	378	298	358
Percentage of inspected found defective	4.8	4.6	4.5	4.9	4.4	5
Number ordered out of service	19	17	16	9	6	12
Number of defects found	1,442	1,385	1,212	1,026	849	928

Table II—Accidents Caused By The Failure of Locomotive Parts and Appurtenances

STEAM LOCOMOTIVE, INCLUDING BOILER, AND TENDER

	Year ended June 30—					
	1947	1946	1945	1944	1943	1942
Number of accidents	360	419	410	403	319	222
Percent increase or decrease from previous year	14.1	2.2[1]	1.7[1]	26.3[1]	43.7[1]	45.1[1]
Number of persons killed	16	10	20	25	27	34
Percent increase or decrease from previous year	60.0[1]	50.0	20.0	7.4	20.6	126.7[1]
Number of persons injured	464	439	429	466	373	227
Percent increase or decrease from previous year	5.7[1]	2.3[1]	7.9	24.9[1]	64.3[1]	24.7[1]

STEAM LOCOMOTIVE BOILER[2]

	Year ended June 30—							
	1947	1946	1945	1944	1943	1942	1915	1912
Number of accidents	116	156	141	141	129	81	424	856
Number of persons killed	12	10	13	17	25	30	13	91
Number of persons injured	124	165	154	194	173	83	467	1,005

LOCOMOTIVES OTHER THAN STEAM

	Year ended June 30—					
	1947	1946	1945	1944	1943	1942
Number of accidents	40	38	29	17	15	9
Number of persons killed	2	..	1	..	..	..
Number of persons injured	41	56	40	23	18	9

[1] Increase.
[2] The original act applied only to the locomotive boiler.

Explosions and Other Boiler Accidents

Fourteen boiler explosions occurred in the fiscal year. Eleven employees were killed in these accidents and 22 were injured. Two explosions were caused by the overheating of crown sheets on locomotives in passenger-train service, nine on locomotives in freight-train service and two on locomotives in charge of engine watchmen. One explosion, on a freight locomotive, was caused by the overheating of the bottom combustion chamber sheet. Three employees were killed in one of the two explosions that occurred while locomotives were hauling passenger trains and eight employees were killed and two injured in three of the nine explosions caused by overheated crown sheets that occurred while the locomotives were in freight-train service. Fifteen employees were injured in the eight remaining explosions caused by overheated crown sheets. Six of these locomotives were in freight-train service and two were in charge of engine watchmen.

The overheating of the combustion chamber which resulted in one explosion in which three employees were injured was caused by the accumulation of sludge in the water space between the bottom sheet of the combustion chamber and the boiler shell. One of the boilers involved in the foregoing explosions was equipped with a low-water alarm. This alarm was so damaged in the explosion that it could not be tested without extensive repairs. However, a test before departure showed that the alarm functioned properly at that time.

Investigations developed that the absence of a safe water level was

Table III—Accidents and Casualties Resulting From Failure of Locomotive Parts

Steam Locomotives and Tenders, and Their Appurtenances

Part or appurtenance which caused accident	Year ended June 30— 1947			1946			1945			1944			1943		
	Accidents	Killed	Injured	Accidents	Killed	Injured	Accidents	Killed	Injured	Accidents	Killed	Injured	Accidents	Killed	Injured
Air reservoirs	1	..	1	1	..	1	1	..	1	3	..	4	..	..	..
Aprons	4	..	4	2	..	2	8	..	8	7	..	7	1	..	1
Arch tubes	..	..	..	..	..	..	..	..	..	1	..	2	..	..	..
Ashpan blowers	..	..	..	1	..	1	2	1	1	..	..	..	1	..	1
Axles	1	2	1	1	..	1	2	..	5	5	1	5	1	..	1
Blow-off cocks	8	..	8	15	..	16	7	..	7	8	..	8	8	..	8
Boiler checks	7	..	7	8	..	8	6	..	6	9	..	9	8	1	7
Boiler explosions:															
A. Shell explosions	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
B. Crown sheet; low water; no contributory causes found	11	7	16	15	7	20	7	9	11	12	7	19	19	22	48
C. Crown sheet; low water; contributory causes or defects found	2	4	3	3	3	2	1	..	1	7	5	43	4	..	6
D. Miscellaneous firebox failures	2	..	4	1	..	1	1	..	1	..	..	..	2	2	2
Brakes and brake rigging	8	..	12	10	..	12	10	..	10	12	..	12	11	..	13
Couplers	6	..	6	5	..	5	5	..	6	6	..	9	3	..	3
Crankpins, collars, et cetera	3	..	3	5	..	5	5	1	4	7	..	9	6	1	9
Crossheads and guides	2	..	2	3	..	5	2	..	2	8	..	8	2	..	2
Cylinder cocks and rigging	3	..	3	1	..	1	1	..	1	3	..	3	4	..	4
Cylinder heads and steam chests	2	..	2	1	..	1	2	..	3	1	..	1	5	..	5
Dome caps	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Draft appliances	..	..	..	2	..	2	2	..	3	2	..	3	1	..	1
Draw gear	1	..	1	1	..	1	2	..	2	1	..	1	1	..	1
Fire doors, levers, et cetera	2	..	2	2	..	2	8	..	8	6	..	6	5	..	5
Flues	4	..	4	10	..	12	5	..	6	8	..	9	5	..	10
Flue pockets	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Footboards	15	..	15	12	..	12	13	1	12	6	..	6	4	..	4
Gage cocks	..	..	..	..	..	..	1	..	1	..	..	..	..	..	..
Grease cups	1	..	1	1	..	1	1	..	1	1	..	1	2	..	3
Grate shakers	20	..	20	25	..	25	17	..	17	19	..	19	18	..	18
Handholds	18	..	18	20	..	20	26	1	25	14	..	14	18	..	18
Headlights and brackets	2	..	2	2	..	2	7	..	7	..	..	..	4	..	4
Injectors and connections (not including injector steam pipes)	14	..	14	14	..	14	12	..	12	8	..	8	7	..	7
Injector steam pipes	4	1	4	2	..	2	1	..	1	..	..	..	2	..	2
Lubricators and connections	4	..	4	5	..	5	4	..	4	5	..	5	7	..	7
Lubricator glasses	..	..	..	2	..	2	1	..	1	1	..	1	..	..	..
Patch bolts	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Pistons and piston rods	1	..	1	..	..	..	2	1	1	3	..	3	1	..	1
Plugs, arch tube and washout	1	..	1	1	..	1	5	2	6	6	3	7	2	..	3
Plugs in firebox sheets	..	..	..	1	..	1	..	..	..	1	..	1	..	..	..
Reversing gear	13	..	13	11	..	11	13	..	13	16	..	16	14	..	14
Rivets	..	..	..	..	..	..	1	..	1	..	..	..	..	..	..
Rods, main and side	3	1	2	7	..	7	7	..	11	7	2	9	7	..	10
Safety valves	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Sanders	5	..	5	4	..	4	8	..	8	12	..	12	2	..	2
Side bearings	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Springs and spring rigging	3	..	77	6	..	7	5	1	4	6	2	8	7	..	8
Squirt hose	19	..	19	14	..	15	23	..	25	21	..	22	16	..	16
Stay bolts	2	..	2	1	..	1	4	..	4	4	1	4	4	..	4
Steam piping and blowers	4	..	4	15	..	15	12	..	14	11	..	14	9	..	15
Valve gear, eccentrics, and rods	4	..	4	7	..	7	7	..	7	10	1	9	3	..	3
Steam valves	8	..	8	13	..	13	7	..	7	7	..	7	9	..	10
Studs	2	..	2	1	..	1	1	..	1	..	..	..	1	..	1
Superheater tubes	2	..	2	2	..	2	4	..	6	2	..	2	4	..	5
Throttle glands	..	..	..	1	..	1	2	..	2	2	..	2	..	..	..
Throttle leaking	2	..	2	1	..	1	2	..	3	1	..	1	1	..	1
Throttle rigging	16	..	17	15	..	16	6	..	6	9	..	9	4	..	4
Trucks, leading, trailing, or tender	2	..	20	10	..	12	5	..	5	5	1	5	3	..	4
Water glasses	8	..	8	12	..	13	10	..	10	14	1	13	11	..	11
Water-glass fittings	3	..	3	2	..	2	1	..	1	2	..	3	..	..	..
Wheels	..	..	..	1	..	1	1	..	1	1	..	1	2	..	2
Miscellaneous	117	1	117	124	..	127	124	3	126	103	1	106	70	1	69
Total	360	16	464	419	10	439	410	20	429	403	25	466	319	27	373

Locomotives Other Than Steam, and Their Appurtenances

Part or appurtenance which caused accident	Year ended June 30— 1947			1946			1945			1944			1943		
	Accidents	Killed	Injured	Accidents	Killed	Injured	Accidents	Killed	Injured	Accidents	Killed	Injured	Accidents	Killed	Injured
Brakes and brake rigging	2	..	2	2	..	3	3	..	8	1	..	3	1	..	1
Carburetors	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Couplers	2	..	2	..	..	..	1	..	4	3	..	3	1	..	1
Crank pins and connecting rods	..	..	..	..	..	..	2	..	2	..	..	..	..	..	..
Fires: Due to overflowing or leakage of fuel, crank-case explosions, back firing, et cetera	7	..	8	4	..	5	6	..	6	4	..	5	3	..	5
Generators and starting devices	..	..	..	..	..	..	..	..	..	..	..	..	1	..	1
Insulation	4	1	5	1	..	1	1	..	1	..	..	..	..	..	..
Pantographs and trolleys	1	1	..	2	..	2	2	1	1	..	..	..	1	..	1
Short circuits	2	..	2	2	..	2	2	..	2	1	..	1	3	..	4
Miscellaneous	22	..	22	27	..	43	12	..	16	8	..	11	5	..	5
Total	40	2	41	38	..	56	29	1	40	17	..	23	15	..	18

known by employees on two of the locomotives in advance of the occurrence of the explosions. Investigations of three explosions developed that dependence had been placed on gauge cocks rather than upon water glasses for indicating the water level. All three gauge cocks on another exploded boiler were found open after the explosion. None survived this accident and no conditions were found that would interfere with the proper operation and correct indications of the water glass.

Anxiety to avoid stalling or to keep trains moving is one of the various factors that lead to the occurrence of such accidents. Shutting off the boiler feeding appliance in efforts to maintain steam pressure should not be indulged in to the extent that a normal safe water level is not readily visible in the water glass. If the water level is being reduced at a rate in excess of that at which water can be supplied to the boiler the rate of working of the locomotive should be adjusted accordingly.

Another contributing factor to these accidents is the equipment of locomotives with boiler feeding appliances of inadequate capacity to supply the maximum quantity of water the boiler is capable of evaporating. The rules contemplate that each locomotive shall be equipped with two such devices, each capable of full stand-by service in the event of the failure of the other. Under many circumstances where maximum performance of the locomotive is required to maintain schedules, reluctance to use the two devices simultaneously occurs and the boiler water is consumed at a rate in excess of that at which it is supplied.

Reliance on gauge cocks without taking into consideration the height of the water in the water glass is another contributing factor. Errors are made in interpreting gauge cock indications. Water glasses should be blown out often enough, and the movement of water therein carefully noted, to insure that the water moves freely. Gauge cocks should be tried frequently to check the level in the glass but a safe level should not be assumed if the bottom gauge cock seemingly indicates the presence of water if none is visible in the glass.

One hundred and two boiler and appurtenance accidents other than explosions resulted in the death of one employee and injuries to 102.

Locomotives Other Than Steam

Forty accidents, resulting in two deaths and 41 injuries occurred in

connection with locomotives other than steam. One employee was killed and two injured as a result of a short circuit between bus bars and a flashover to a cab bulkhead on an electric locomotive. One employee was killed on another locomotive by contact with an energized pantograph when an attempt was made to pass through a roof hatch, the door of which was open due to interference of an improperly assembled safety attachment to the grounding switch.

Six explosions occurred in crankcases of engines of Diesel-electric locomotives, resulting in injuries to seven employees. Five of these explosions were caused by overheated bearings, and one was caused by an overheated cylinder liner and piston due to inoperative water-cooling system shutters.

Two of the explosions caused by overheating of the bearings occurred when attempts were made to restart the engines after having been shut down because of emission of smoke from the valve covers and other indications of overheating; one occurred after the engine was taken off the line and the speed reduced because of unusual noise and low oil pressure; one occurred following shut down of the engine as a crankcase inspection cover was being removed to determine the source of a pounding noise. Another occurred following shut down of the engine because of smoke and a light explosion which forced off a valve cover; the second explosion forced off all valve covers and eight inspection covers and ignited the oil in the crankcase. The explosion caused by an overheated cylinder liner and piston occurred after the engine speed had been reduced to about one-half of normal because of the excessive temperature of the cooling water due to closed cooling system shutters.

Table IV—Number of Steam Locomotives, Reported, Inspected, Found Defective, and Ordered Out of Service

Parts defective, inoperative or missing, or in violation of rules	Year ended June 30— 1947	1946	1945	1944	1943	1942
1. Air compressors	944	1,044	1,054	1,146	968	829
2. Arch tubes	19	27	17	45	50	27
3. Ashpans and mechanism	87	93	81	93	71	80
4. Axles	6	7	11	15	15	2
5. Blow-off cocks	308	388	361	289	291	238
6. Boiler checks	428	526	511	533	503	393
7. Boiler shell	342	462	416	406	377	290
8. Brake equipment	2,512	2,992	2,755	2,914	2,661	2,382
9. Cabs, cab windows, and curtains	1,347	1,501	1,057	1,169	1,102	1,163
10. Cab aprons and decks	428	469	426	381	390	335
11. Cab cards	91	120	91	104	142	131
12. Coupling and uncoupling devices	58	46	57	65	66	70
13. Crossheads, guides, pistons, and piston rods	1,683	1,941	2,079	2,149	1,961	1,273
14. Crown bolts	98	88	90	105	66	75
15. Cylinders, saddles, and steam chests	2,004	2,217	1,801	2,133	1,395	1,514
16. Cylinder cocks and rigging	650	679	454	624	430	521
17. Domes and dome caps	130	164	187	189	196	112
18. Draft gear	449	536	486	576	599	651
19. Draw gear	453	462	447	515	469	369
20. Driving boxes, shoes, wedges, pedestals, and braces	1,580	1,922	1,803	2,026	2,053	1,743
21. Firebox sheets	257	333	319	347	303	255
22. Flues	197	253	260	274	215	178
23. Frames, tail pieces, and braces, locomotive	820	1,003	852	1,019	894	869
24. Frames, tender	63	88	97	126	86	86
25. Gages and gage fittings, air	135	185	151	158	191	193
26. Gages and gage fittings, steam	358	370	353	328	316	263
27. Gage cocks	404	495	449	532	584	497
28. Grate shakers and fire doors	444	555	558	539	492	491
29. Handholds	469	540	527	464	483	378
30. Injectors, inoperative	39	50	41	46	66	47
31. Injectors and connections	2,369	2,750	2,553	2,867	2,637	2,220
32. Inspections and tests not made as required	350	8,885	9,067	9,565	9,037	8,186
33. Lateral motion	791	862	977	898	700	498
34. Lights, cab and classification	155	161	167	243	184	131
35. Lights, headlight	143	168	222	268	184	218
36. Lubricators and shields	228	351	306	257	292	234
37. Mud rings	217	238	257	301	256	244
38. Packing nuts	575	691	654	746	669	689
39. Packing, piston rod and valve stem	691	776	845	879	724	738
40. Pilots and pilot beams	156	153	171	193	194	188
41. Plugs and studs	236	262	245	281	259	173
42. Reversing gear	528	482	439	454	452	411
43. Rods, main and side, crank pins, and collars	2,136	2,581	2,569	3,230	2,798	1,986
44. Safety valves	70	72	84	77	74	67
45. Sanders	569	784	658	609	642	738
46. Springs and spring rigging	4,622	5,195	4,734	4,625	3,583	3,349
47. Squirt hose	79	120	98	94	92	67
48. Stay bolts	318	360	351	400	367	272
49. Stay bolts, broken	283	268	308	232	247	274
50. Steam pipes	356	551	416	435	414	290
51. Steam valves	146	203	157	161	159	150
52. Steps	778	914	681	872	729	594
53. Tanks and tank valves	1,558	1,570	1,215	1,400	1,321	1,150
54. Telltale holes	69	60	78	69	78	79
55. Throttle and throttle rigging	1,026	979	948	948	887	786
56. Trucks, engine and trailing	1,005	1,261	1,151	1,155	1,020	833
57. Trucks, tender	795	1,101	974	928	900	786
58. Valve motion	778	1,080	991	1,021	998	779
59. Washout plugs	441	740	820	845	685	569
60. Stokers	208	...	...	...	...	...
61. Water glasses, fittings, and shields	1,318	1,190	1,328	1,323	1,454	1,133
62. Wheels	583	840	899	759	728	664
63. Miscellaneous — Signal appliances, badge plates, brakes (hand)	870	1,337	1,213	1,172	1,151	977
Total number of defects	41,250	56,541	53,367	56,617	51,350	44,928
Locomotives reported	39,578	41,851	43,019	43,297	43,064	42,951
Locomotives inspected	94,034	101,869	115,979	117,334	116,647	113,451
Locomotives defective	10,248	11,337	11,975	12,710	11,901	10,970
Percentage of inspected found defective	11	11	10	11	10	10
Locomotives ordered out of service	708	690	506	630	487	474

The rapidly expanding and intensive use of Diesel-electric locomotives and repetition of accidents caused by crankcase explosions accentuates the need for a higher degree of maintenance of Diesel engines and the necessity of operators of these engines being fully informed of the hazards involved in continuing the engines in use when undue heating occurs. In instances of low lubricating oil pressure or abnormal heating, engines should be shut down promptly and the restarting of an overheated engine should not be attempted unless it is known that the engine has cooled to normal temperature and the cause of overheating has been found and remedied.

It is not uncommon for crankcase explosions to occur after overheated engines have been shut down and before the overheated parts have cooled sufficiently to avoid ignition of the vapor in the crankcase. The entry of air into the crankcase or other conditions may affect the vapor mixture to such extent as to change the explosive characteristics and explosion may occur before the overheated parts have cooled to below the flash point of the vapor which is variable in composition and unknown under the circumstances. It is therefore advisable for attendants or others present to depart promptly from close proximity to any engine that has been shut down because of smoke coming from the valve covers, incipient crankcase explosions or any excessive overheating, until cooling has occurred. The crankcase handhole covers or inspection covers or doors should not be loosened or removed until it is known that a sufficient interval of time has elapsed for cooling of any heat-affected parts below the flash or fire point of the contents of the crankcase.

Amended Rules

The appliances required by amended rules 106 (b), 153 (a), and 157 (c) and (d) to be installed on steam road locomotives the first time class 3 repairs are applied

but not later than June 1, 1948, consist of an emergency brake valve located on the front of the tender, on the rear of the back wall of the cab, or adjacent to a cab exit if the cab is of the vestibule type; a device whereby the height or quantity of water in the tender feed water tank may be ascertained from the cab or tender deck; and steam or a supply of auxiliary air to air-operated reverse gears.

Installation of these safety aids was started at or shortly after the time the order amending the rules was issued; some delays, spotty rather than general, were encountered because of shortage of materials and parts, but considerable progress is now being made. However, the following irregularities have been found in some of the installations and suitable action taken toward correction:

Emergency brake valve—Mounted on the rear of the back wall of the cab at such height as to be liable to catch the clothing of a person passing through the gangway.

Tender feed water height indicator—Devices of the general type that consist of a vertical pipe, either inside or outside the tank, with a valve at the bottom manually operable from the top of the tank bulkhead by means of which water from the tank is admitted into the bottom of the pipe and the level indicated by water discharging from a series of holes, nipples, or street ells in the pipe, or nipples connecting the pipe to holes in the side plate of the tank. The water valve is subject to seizure and at times cannot be opened; the water valve leaks, provision is not made for indicating the lower levels of water in water bottom tanks, discharge openings are closed by corrosion or foreign material, some being plugged with wood or pin grease and in some instances welded closed; the device is subject to becoming inoperative in cold weather due to freezing, discharge of water so near the tender vertical handhold and gangway steps that ice forms on these parts in cold weather, in some instances discharge of water is so located that it can be seen only by looking back through the side cab window when open or by extending the head out of the gangway.

Devices consisting of a gauge or liquid in a U-tube actuated by air pressure sufficient to balance a column of water equal in height to the level of the water in the tank—various irregularities of these devices have been found to be due to lack of proper maintenance, such as air screen or pipes plugged by foreign matter and leakage in air or water connections.

Various kinds or types of devices for ascertaining the height or quantity of water in the tender tank have been applied by different carriers, apparently in some instances without giving thorough consideration as to the suitability of the designs or constructions to effect the purpose of the Commission's order establishing the amendment of the rule. Some of these devices have been supplanted with other devices and others will be modified as a result of experience under the particular services and locations where the locomotives are used; those found to comply with the intent and purpose of the rule will be continued in use.

As with other rules requiring the installation of locomotive devices or accessories the choice of make, type, details or design, and method of application rests, for obvious reasons, with each carrier involved. The Bureau does not undertake recommendation or approval of any particular design or any particular device but it is required that the purpose sought be reasonably accomplished.

Power reverse gear—The valve handle of the steam connection to an air-operated power reverse gear, where such supplementary means of operation is used, is required to be plainly marked and equipped with a handle or wheel of distinctive design. Suitable marking has generally been applied, but in some instances the handle is of the same size and design as used on other steam valves in cabs. It is the intent of the rule that the handle be of different design than that of other valves on the locomotive and that all such handles used on locomotives of any particular carrier be alike.

Appeals—No formal appeal by any carrier was taken from the decisions of any inspector during the year.

Table V—Number of Locomotives, Other Than Steam, Reported, Inspected, Found Defective, and Ordered Out of Service

Parts defective, inoperative or missing, or in violation of rules	Year ended June 30—					
	1947	1946	1945	1944	1943	1942
Air compressors	9	15	14	7	7	13
Axles, truck and driving	2	...	...	...	6	...
Batteries	1	2	...	1	2	1
Boilers	5	11	8	...	1	5
Brake equipment	178	102	114	85	62	86
Cabs and cab windows	97	46	59	40	33	27
Cab cards	29	24	25	21	17	20
Cab floors, aprons, and deck plates	130	72	60	54	31	10
Clutches	...	2	2	1	2	1
Controllers, relays, circuit breakers, magnet valves, and switch groups	14	16	18	14	9	12
Coupling and uncoupling devices	13	6	6	3	1	5
Current collecting apparatus	3	9	10	...	1	1
Draft gear	30	18	14	14	15	19
Draw gear	4	3	8	...	2	3
Driving boxes, shoes, and wedges	38	44	29	12	25	16
Frames or frame braces	7	10	12	12	7	5
Fuel system	66	57	45	33	32	81
Gages or fittings, air	10	7	7	6	3	8
Gages or fittings, steam	5	...	...	2	1	...
Gears and pinions	1	...	...	1	4	4
Handholds	22	18	13	6	19	14
Inspections and tests not made as required	78	357	297	278	223	274
Insulation and safety devices	11	12	17	8	4	3
Internal-combustion engine defects, parts and appurtenances	254	145	133	86	50	62
Jack shafts	3	4	6	8	2	1
Jumpers and cable connectors	1	8	9	2	3	1
Lateral motion, wheels	7	18	20	9	10	...
Lights, cab and classification	1	2	...	1	1	5
Lights, headlight	2	...	1	2	2	1
Meters, volt and ampere	3	4	2	2	3	2
Motors and generators	16	15	12	14	14	16
Pilots and pilot beams	15	8	1	2	4	10
Plugs and studs	...	...	1	...	...	...
Quills	18	52	29	18	9	6
Rods, main, side, and drive shafts	6	11	3	10	...	2
Sanders	82	57	50	59	41	57
Springs and spring rigging, driving and truck	63	42	38	44	18	35
Steam pipes	4	1	6	3	1	...
Steps, footboards, et cetera	68	29	28	25	25	21
Switches, hand-operated, and fuses	1	...	7	2	2	2
Transformers, resistors, and rheostats	2	3	...	...	3	3
Trucks	45	52	42	47	22	28
Water tanks	2	1	2	1	4	1
Water glasses, fittings, and shields	...	15	2	4	2	5
Warning signal appliances	8	2	...	2	3	3
Wheels	48	54	46	74	107	43
Miscellaneous	40	31	16	13	16	14
Total number of defects	1,442	1,385	1,212	1,026	849	926
Locomotive units reported	7,805	6,616	6,094	5,139	4,351	3,957
Locomotive units inspected	13,115	10,908	9,888	7,711	6,847	6,728
Locomotive units defective	633	499	447	378	298	358
Percentage inspected found defective	4.8	4.6	4.5	4.9	4.4	5
Locomotive units ordered out of service	19	17	16	9	6	12

The Chicago & North Western is constructing a plant for the treatment of enginehouse waste, including oil, at its Chase Yard enginehouse in Milwaukee, Wis., at a cost of $27,500.

S.L.R.X. Plywood Refrigerator Cars

Fifty new 40-ton steel ply-wood refrigerator cars provide unusually sturdy designand insulation efficiency

Early in 1947 the Saint Louis Refrigerator Car Company placed in service 50 new 40-ton refrigerator cars, built at its own shops at St. Louis, Mo., and generally similar to a series of 25 composite steel-plywood cars, built in the same shops in 1940. These cars embody many refinements in design as a result of service experience with the earlier series of cars, but the earlier cars were so successful in general performance that the company built 100 additional cars during the fall.

Built essentially of copper-bearing steel underframe and superstructure frame parts, supplied by the Mt. Vernon Car Manufacturing Company, Mt. Vernon, Ill., the cars utilize Douglas Fir plywood of various grades to meet specific requirements for the side wall, roof, floor construction and inside lining. This plywood was furnished by the Harbor Plywood Corporation, Hoquiam, Wash.

The 1940 refrigerator-car design was unusual due to the extensive use of dead-air space for insulation in all parts of the cars. On the last lot of cars, the dead-air-space principle of insulation was also employed, but Naturzone board-form insulation was added in the sides, ends, roofs and floors and Haircraft blanket-form insulation in the floors. The principle advantage in using this additional insulation is that the large dead-air spaces are now broken up into smaller and more efficient dead-air spaces, which supplement the insulating value secured from the insulation material itself.

The lightweight of the 1940 refrigerator car was 54,100 lb., an average saving of 6,000 lb. per car over conventional tongue-and-groove wood being credited to the plywood construction. On the first fifty 1947 cars, the lightweight averaged 54,852 lb., this increased weight being due to addition of the insulation previously mentioned, increasing the thickness of the plywood in the floor and outside sheathing, and increasing the weight of center sills, all of which changes were made to realize alonger life of the particular parts involved.

In the 1940 cars, screws were extensively used to secure the plywood in place, advantages being claimed due to the increased holding power of the screws. Experience of the Saint Louis Refrigerator Car Company indicates that screws do not serve the purpose as well as cement-coated barbed car nails and, in fact, the screws break off, causing the plywood to become loose.

Details of the Construction

The 1940 cars were equipped with 80,000-lb. capacity, spring-plankless, National Type-B trucks, with 5-in. by 9-in. journals, one-wear wrought-steel wheels, also with drop-forged journal wedges, Type-E double-coil truck springs with one Cardwell Type P-8-1 friction spring per frame, and Barber adjustable roller side bearings. Cars completed in 1947 are equipped with the A. S. F. A-3 Ride-Control truck, with 5-in. by 9-in. journals and one-wear wrought steel wheels, drop-forged journal wedges, 16 double-coil and 4 single-coil 5½-in. by 10$\frac{9}{16}$-in. springs with 3¾-in. travel. This truck does not require the use of any friction springs, the snubber unit being built in. The Barber adjustable roller side bearing is still used.

Cars built in 1940 were equipped with Cardwell type L-25-SA draft gear with Universal cast steel vertical-type yokes 6-in. by 1½-in. yoke keys, secured with

A. A. R. retainers, and Type-E 6¼-in. by 8-in. rigid-shank, bottom-operating couplers with A. A. R. bottom-lift release rigging. The only change in the 1947 cars is that Cardwell M-25 draft gears are used instead of the Cardwell L-25-SA type.

The 1940 cars were equipped with Westinghouse AB-10 freight-car brakes and Universal type XL hand brakes, with extra-heavy pipe and pipe fittings throughout. There is no change in brake equipment on the 1947 cars with the exception that Universal No. 2109-A brake adjusters are added.

The steel-frame construction is the same as described in the earlier *Railway Age* article, with the following exceptions: The center sill has been increased from 36.21 lb. per ft. to 41.2 lb. per ft. End braces have been changed from 5-in. by ¼-in. plate to ¼-in. pressed steel, being formed the same as other posts and braces. They are now secured to the steel end and steel transom post by 5-in. by 5/16-in. plates, these plates being riveted to the steel end, the end braces and the transom posts. These changes in the center sill and end braces were made to secure more strength in these parts of the cars, which is required on account of the heavy and bulky ladings carried.

The only change in the body framing is the substitution of 5-in. by 5½-in. fir corner posts, which are now applied in sections, whereas in the cars built in 1940, 5-in. by 5½-in. oak corner posts were applied in one piece. This permits removing a section of the corner post to straighten the steel corner post, when cars are damaged, whereas it was formerly necessary to remove the entire post.

Double fir belt rails 4¼-in. by 4¾-in. in the 1940 car are supplemented by an additional fir belt rail of the same size which is applied between the lower belt rail and the side sill, at approximately the floor level. This facilitates more efficient attachment of the plywood inside lining and plywood outside sheathing at the floor level of the car.

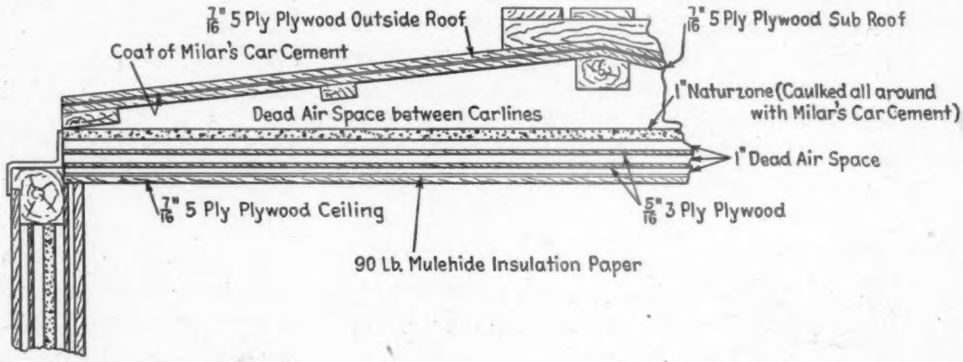
The floor construction is substantially the same in both cars with the exception of an added course of 90-lb. Mulehide insulation paper over the lower course of 5/16-in. plywood between the sills in the 1947 design, also a course of ½-in. quilted Haircraft insulation over the top course of 5/16-in. plywood insulation between the sills, and a course of 1-in. Naturzone and 90-lb. Mulehide insulation paper over the sub-floor. The Haircraft blanket-form insulation and Naturzone board-form insulation were furnished by Wilson & Company.

The plywood drain floor is changed from 9/16 in. to ⅝ in. and the spline joint is replaced by a butt joint, which a coat of Milar's No Krode lap-and-joint sealer makes watertight.

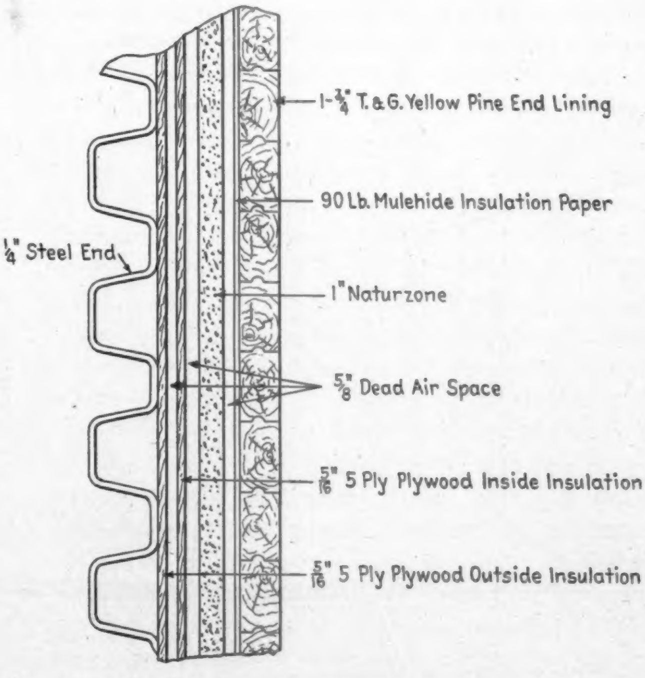
Side wall construction is the same as on the cars built in 1940, with the exception of an added course of 90-lb. Mulehide insulation paper just beneath the inside lining. A course of 1-in. Naturzone is also applied in the center of the space between the inside and outside plywood insulation. In this manner, the 3-in. dead-air space in the cars built in 1940 is changed to two 1-in. dead-air spaces and a course of 1-in. Naturzone.

On the outer face of the outside course of 5/16-in. plywood insulation, a course of 15-lb. insulation paper is applied and just beneath the outside sheathing is a course of 90-lb. Mulehide insulation paper. The outside sheathing has been increased from ½ in. to 9/16 in. in thickness.

The end construction has also been changed by applying 1¾-in. by 5¼-in. tongue-and-groove end lining in place of the ¾-in. plywood end lining used in the cars built in 1940, this change being made in order to have at least this thickness of lumber in the end lining to withstand extreme lading pressure. Plywood 1¾ in. thick could be used, but the added cost would hardly be justified.



Detail of roof insulation



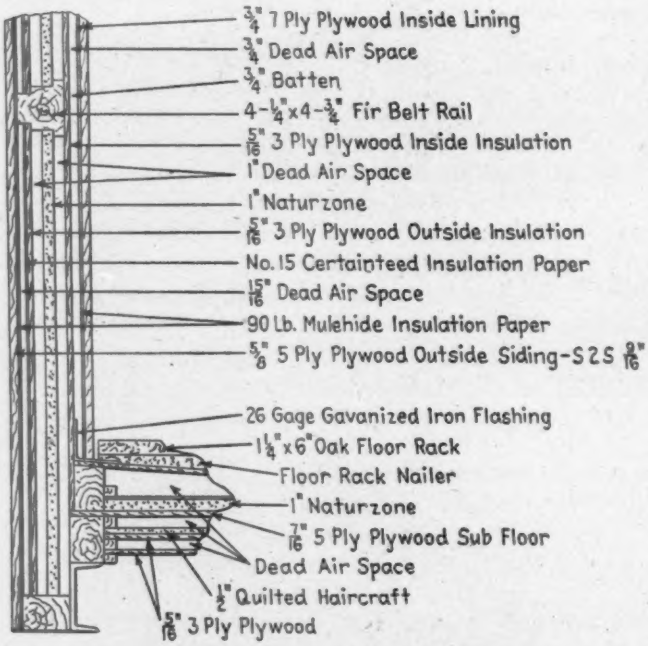
Detail of end insulation

Just beneath the end lining is a course of 90-lb. Mulehide insulation paper. The spacing of two courses of 5/16-in. plywood insulation has also been changed and a course of 1-in. Naturzone added between the end lining and the first course of 5/16-in. plywood insulation, this change being made for added insulation efficiency.

In order to improve still further the insulating effi-

ciency of the cars, spaces in the U-section of the pressed-steel posts and braces have been filled in with 2-in. by 2½-in. Naturzone insulation.

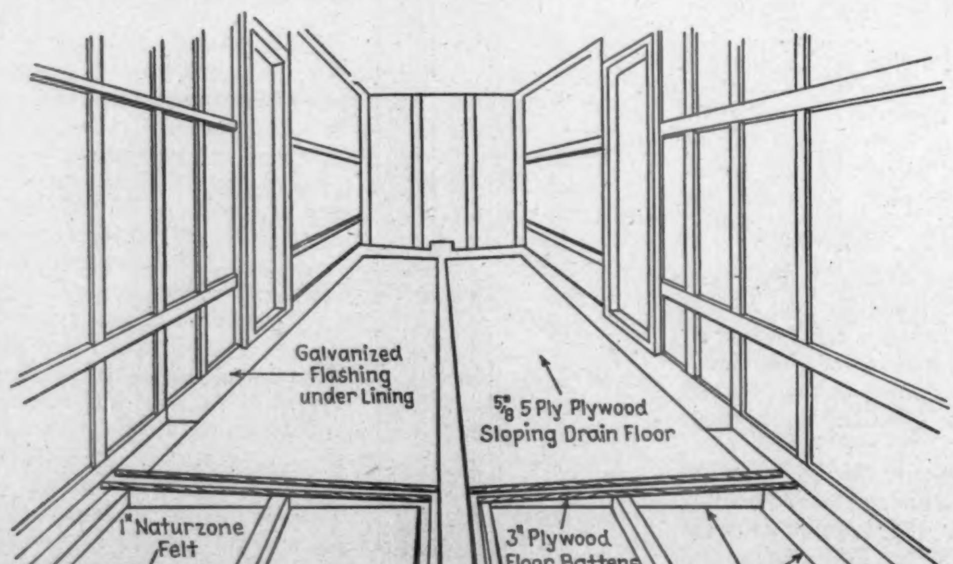
Roof construction of the 1947 design cars is again sub-



Side wall and floor insulation

stantially the same, except for an added course of 90-lb. Mulehide insulation paper next to the ceiling, different spacing of the 5/16-in. plywood insulation between the carlines and an added course of 1-in. Naturzone.

In the 1940 cars, all roof lap joints are coated on the



Detail of floor construction

underside with roof packing compound. In the new cars a coating of roof packing compound is applied over the entire roof between the sub-roof and outside roof, which acts as a binder and, in effect, gives a 7/8-in. plywood roof, but should it be desired to renew the utside plywood roof on account of wear or any other reason, it will not be necessary to disturb the sub-roof. The application of this roof packing compound also eliminates weaving of the roof while cars are in motion, which places considerable strain on the nails used to secure the roof.

In the 1940 cars, galvanized-iron caps are set in grooves on the saddles. These caps have been eliminated and replaced with a No. 3 heavy roof paper caps which extend over the sides and edges of the saddles. In this manner the saddles are completely protected from weather and moisture. As already mentioned, 2-in. hot galvanized recessed-head wood screws used to secure the outside roof have been eliminated and replaced by cement-coated barbed car nails which hold much better than the screws.

In order to protect the plywood roofs from the sun and eliminate all grain raise, the entire roof is covered with approximately 1/8 in. of Mortex No. 4 liquid asphalt, which is applied by spray after a coat of Milar's No Krode primer sealer and a coat of mineral paint are applied to the outside face and all edges of the outside plywood roof. Over this Mortex, a coat of tile-red slate granules is sprayed which gives an attractive appearing roof adequately protected against any grain raise.

General Dimensions of S. L. R. X. 40-Ton Plywood Refrigerator Cars Built in 1947

Nominal capacity, lb.	80,000
Load limit, lb.	81,200
Light weight, lb.	54,800
Cubic capacity, cu. ft.	2,395
Inside length, ft.-in.	40–0
Inside width, ft.-in.	8–2
Inside height, ft.-in.	7–4
Extreme width, ft.-in.	10–2
Height at extreme width, ft.-in.	12–1
Height to top of running board, ft.-in.	13–4
Height top of roof grab iron, ft.-in.	13–6
Height to door opening, ft.-in.	4–5
Door width, ft.-in.	4–0
Door height, ft.-in.	6–0
Length over running board, ft.-in.	42–8
Length over corner post, ft.-in.	41–0
Length over strikers, ft.-in.	42–0
Length over couplers, ft.-in.	45–0

EDITORIALS

A Look At The Record

The latest annual report of the I.C.C. Bureau of Locomotive Inspection for the fiscal year ending June 30, 1947, showed that, while the number of steam locomotives for which reports were filed was only about five times as many as all other locomotive types combined, they developed about 30 times as many defects, and over 37 times as many had to be ordered out of service. The report covered over 39,000 steam locomotives and nearly 8,000 locomotives other than steam. More than 94,000 inspections were made on steam locomotives and in excess of 13,000 on locomotives other than steam. The locomotives inspected that were found defective amounted to 11 per cent for steam power and 4.8 per cent for locomotives other than steam. Of the number found defective, 7.5 per cent of the steam locomotives had defects serious enough to warrant their being ordered out of service, while only 1.25 per cent of the locomotives other than steam warranted withdrawal from service.

What is inherent about the steam locomotive to cause its record on paper to look so poor alongside competing forms of motive power? Is it because the average age of steam power is substantially greater than that of other locomotives? Is it because a large amount of this old steam power is used in secondary service, especially on roads which are heavily Dieselized, thereby causing some roads to feel that inferior maintenance standards are justified? The effect of either or both of these factors on the total situation appears to be minor. Does the basic design of the steam locomotive lend itself to the occurrence of more defects, or to defects that are more serious, or to defects that are both more numerous and more serious, than the design of other forms of motive power? Other figures found in the Bureau's report tend to refute this. The number of accidents caused by the failure of steam locomotive parts and appurtenances was nine times that of locomotives other than steam with eight times as many people killed. These figures, unlike the ratios of 30 and 37 between the two categories of locomotives found defective and those ordered out of service, are more nearly in line with the ratio of locomotive units for which reports were filed.

A likely reason for the larger ratio of steam locomotives either found defective or ordered out of service to the total inventory in service is the relative neglect which the steam locomotive receives as compared to its competitors, principally the Diesel-electric locomotive. Many railroad men feel that if steam power were given even a fraction of the care that Diesel power receives it would give a much better account of itself as regards maintenance cost, availability and utilization. While the figures from this latest Bureau report may not prove this contention, they do show that steam locomotive maintenance is not given the attention that the maintenance of competitive motive power receives. The figures show further that the ratio of accidents to the total inventory is not substantially different between steam and other forms of motive power, despite the lesser attention given to steam power as shwn by the ratio of defects, thus suggesting that steam locomotives are not naturally addicted to defects. Together, the two sets of figures form a good basis for furthering the argument of those who believe that giving good care to steam locomotives will result in lower operating and maintenance costs as well as increased availability and utilization.

Grinding Diesel Crankshafts

At least one crankshaft is required in each Diesel locomotive unit operated by the railroads and to a first cost of upwards of $5,000 per crankshaft for the largest size must be added a maintenance cost of $4 to $500 for each regrinding within wear limits and probably twice that much if the shaft bearings are metallized or built up by other means and reground to standard size must be added a maintenance cost of $4 to $500 expense and delay of shipment to and from the manufacturer's or other plant where regrinding is done. It frequently takes several weeks for crankshafts to be reconditioned and returned and consequently protection stock must be carried in the stores department at some overhead expense, or valuable Diesel locomotives will be held in shop and out of revenue service.

This statement is by no means an indictment of the crankshafts on modern Diesel locomotives which, by and large, are rendering really remarkable service with demonstrated performances of well over one million miles between grindings in road service and six to eight years in switchers. True, numerous crankshafts in all makes and types of Diesel locomotives are breaking, but usually due to traceable service conditions rather than defects in material or design, and the total number is but a small percentage of those in use. For example, one of the largest users of Diesel locomotives had only three broken crankshafts in 1947 out of a total of 336 in service, or 0.9 per cent.

Broken crankshafts are of course scrapped and replaced, but those which become worn or scored in service have to be reground and, in spite of the long service life, railroads with an ever-increasing inventory of Diesel motive power will eventually be faced with the establishment of some definite policy regarding the

maintenance of crankshafts which comprise, in effect, the foundation on which every good-performing Diesel engine is built.

The way in which one prominent midwestern railroad has answered this question for itself by installing a modern Diesel crankshaft grinding machine is described in an article elsewhere in this issue. The machine cost $87,000 installed and, before making an investment of this magnitude, a comprehensive study was undertaken to determine its justification. Figures of total ownership of Diesel crankshafts and miles between grinding were used to find out how many crankshafts would need grinding each year. The reduction in number of shafts needed for protection service was taken into consideration; also the saving in cost of shipment to outside points for grinding and, even more important, the saving in shop days required for valuable Diesel power.

In figuring the cost of refinishing Diesel crankshaft bearings in a railroad shop, the estimated shop cost was set up to include not only direct labor and regular shop expense but fixed charges on the investment, the latter including 4 per cent for interest, 3⅓ per cent for depreciation, 1 per cent for insurance and taxes and .67 per cent for machine repairs, or a total of 9 per cent per annum. Taking into account all items of relative cost, the machine showed a saving of about 13 per cent on the investment during the first year of operation, with every indication that this return will be higher each year for several years as the volume of work increases.

Sealed Compressors and A. C. Power

At various times in the past few years, railroad operators have expressed the wish that they might have an eight-ton, hermetically sealed refrigerant compressor for use on air-conditioned cars. Manufacturers have objected to developing such a device on the ground that it could not be operated satisfactorily as an air-cooled device on a railroad passenger car. Head pressures, they state, would run too high, and temperatures would reach a point at which freon, in the presence of iron acting as a catalyst, would react with lubricating oil to form a compound which would destroy motor insulation.

Sealed air conditioning equipment designed to overcome this difficulty has been tried out on the C. M. St. P. & P. After extensive tests, it was removed from the car and since that time it has been redesigned and is ready for re-application. The improved system is described in this issue in an article entitled "A. C. Air Conditioning." As the title indicates, the compressor is for use only with alternating current power.

Designers of car electrical apparatus have been reluctant to use inverters larger than 5 kw. for changing d. c. power to a. c. power because of the considerable power losses involved. If this opinion continues, it would seem to preclude the use of sealed compressors on cars having d. c. power sources. But in the system described in this issue, the power source is an a. c. generator driven by a Diesel engine, and there are no conversion losses. Furthermore there are two compressors of relatively small size and, under high ambient temperatures and high cooling loads, some water is borrowed from the car water supply to sustain capacity and keep head pressures and temperatures within bounds. Water cooling such as this is not untried since the sub-cooler used with propane-engine-driven compressors has long been a regular part of this equipment.

The fact that the sealed compressor must be driven by an a. c. motor indicates it must have power supplied from a power car or from an engine-driven generator on the car. There seems to be little probability that power cars can find wide application because of the difficult standardization problems involved. This means that power must come from an engine on the car and this is almost an untried field insofar as engines driving 25-kw. generators are concerned. But five manufacturers are now offering such power plants for railroad application and this makes it appear that such equipment will soon be in regular railroad service.

Freight-Car Weight Reduction

When the possibilities for the reduction of freight-car weights were being studied by the railroads and exploited intensively by the builders about ten years ago, it was found that hopper cars could be designed and built with weights which permitted a ratio of pay load to gross load of upwards of 82 per cent. Under present standard practice, however, the minimum braking ratio for gross loads at the rail is not to be less than 18 per cent, preferably 20 per cent, of the gross load, and the maximum braking ratio of the empty car, as set forth in Interchange Rule 3, is not to exceed 75 per cent of the tare weight. For cars equipped with a single-capacity brake, these provisions limit tare-weight reductions to a point at which the ratio of pay load to gross load does not exceed 76 per cent. This makes a difference in the light weight of a 50-ton car of about 11,000 lb.

It has been evident for some time that the need for the additional expenditure required to equip cars with dual-capacity or variable-load brakes has tended to place a limit on weight reduction at a pay-load-gross-load ratio of approximately 75 per cent. To what extent has this limit actually been reached in practice?

Some answer to this question may be obtained by an examination of weights of the freight cars ordered during 1947 for which nominal weights are available. In the case of 50-ton hopper carts the weights of nearly two-thirds of those ordered are less than the minimum at which the single-capacity brake will meet both maximum and minimum braking ratios, and the heaviest cars are a fraction of a ton over that minimum. The weights of nearly half the 70-ton hoppers are below

the single-capacity brake minimum and this minimum is exceeded by not more than two and one-half tons. A few more than 10 per cent of the 50-ton gondolas weigh less than the single-capacity brake minimum; half exceed the minimum by less that 1,500 lb., and the heaviest exceed the minimum by less than two tons.

The number of 70-ton gondolas for which nominal weights are available is small, but several orders exceeded the single-capacity brake minimum by more than four tons. In one case the excess is over nine tons. About one-sixth of the 50-ton, 50-ft. 6-in. box cars ordered have nominal weights less than the single-capacity brake limit, and most of them exceed the nominal weight by a ton or more. The maximum excess is nearly two and one-half tons.

Obviously, this is a very rough check. However, it indicates that, in the case of hopper cars, the single-capacity brake minimum has not been too serious a barrier to weight reduction and that where the weight has not been reduced below the minimum, it has approached it in many cases. The same statement applies almost as well to 50-ton gondolas, but not to the 70-ton gondolas. The field for the reduction of box-car weight is considerably greater than in the case of open-top cars before the single-capacity brake minimum becomes a barrier to further weight decrease.

Increasing Cost of Obsolete Shop Facilities Reduces Profits

From the standpoint of layout and construction as a complete plant the newest railroad shop devoted almost exclusively to the repair of steam locomotives is 16 years old. In making this statement, we deliberately did not say the *most modern* railroad shop for the reason that in the past 16 years some roads having a long-range planning program for the modernization of shop facilities have continually replaced many of the units of machine tools and shop equipment and made changes in the arrangement of shop departments which, from a standpoint of production, have served to modernize shops that were built many years ago.

In drawing attention to the fact that the newest steam locomotive repair shop is now 16 years old it is of especial significance to point out that in 1947 the road operating that shop made extensiv eappropriations and purchases for the modernization of shop facilities. Most of our steam locomotive repair shops are many years older than 16 years and when it is considered that the management of a railroad having a repair shop that is *only* 16 years old considers it important to make extensive expenditures for the replacement of machine tool and shop equipment units it gives us cause to wonder why the managements of many other roads having shops many years older than that have been so reluctant to consider the opportunities for economies by way of shop modernization.

The entrance of the Diesel-electric locomotive into the motive power picture during the last few years has concentrated the attention of railroad management on that type of power, the problems of its maintenance and the necessity of providing facilities to carry out maintenance work that is peculiar to Diesel-electric locomotives. The job that the Diesel has done for the railroads is oen that has caused the operating departments to look upon this type of power as the answer to its future requirements and it is natural that railroad management should pause to consider the future course of motive power policies before embarking upon expenditures for maintenance facilities that mihgt ultimately prove to have been made in the wrong direction. This attitude may account, in part, for the fact that not too much attention has been given recently to shop modernization programs for steam locomotive repair shops.

The fact that 88 per cent of all the locomotives in the United States are steam locomotives may have something to do with a recent change in thinking on the part of many railroads. It makes no difference as far as motive power maintenance policies are concerned whether 12 per cent of the motive power units on an individual road are Diesel or whether the percentage may be two or three times that figure. The fact remains that at the present time the greater proportion of the motive power on almost any important railroad is steam power and in spite of anything that can be done the proportion of steam power will remain the greatest for several years to come. This being the case, the major part of the motive power maintenance job on any railroad for several years to come will be to maintain steam power efficiently and economically.

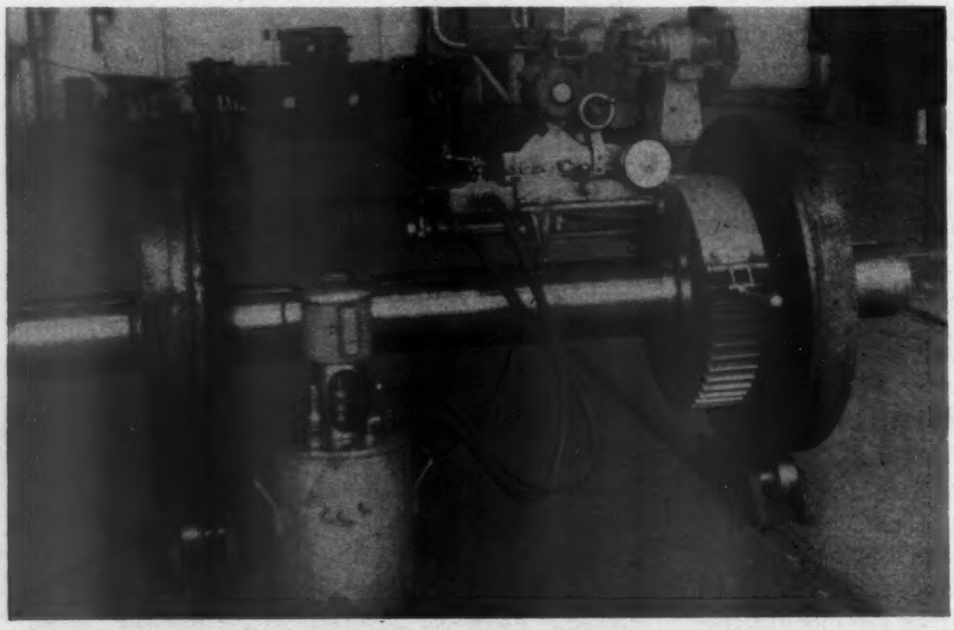
Each year the average age of machine tool and shop equipment units in steam locomotive repair shops increases. From the standopint of the ultimate measure of machine tool life—machine hours—every machine in a locomotive shop that was in that shop before the war is many years older than it would have been had not the pressure of shop operation during the war years existed. If, as such was the case, as much as 70 per cent of the machine tool units in a railroad shop were over 20 years of age before the war, it is obvious that the percentage has increased in average age, and in obsolescence, as each year has gone by.

With the great increases in the cost of materials and labor the necessity for economy in shop operation are greater than ever before and, fortunately the developments in machine tools, tooling equipment and equipment for reducing the handling time of locomotive parts while they are being processed in the shop offer greater opportunities for economies than ever before. It may therefore be worth while, again, to call the attention of management to the fact that if it allows obsolescence in the facilities with which 88 per cent of the locomotives of the country are maintained it is conceivable that the incrasing cost of steam power maintenance may easily dissipate a substantial part of the savings that are being credited to the use of Diesel power.

IN THE BACK SHOP AND ENGINEHOUSE

Portable Gear-Tooth Grinder

The portable grinder illustrated, which is used primarily for removing shoulders on worn traction-motor ring gears at the West Burlington Diesel shop of the Chicago, Burlington & Quincy was designed and built by local shop forces. It traverses an electrically driven, formed abrasive wheel back and forth by hydraulic power over one gear tooth at a time until the shoulders developed by service wear are removed.



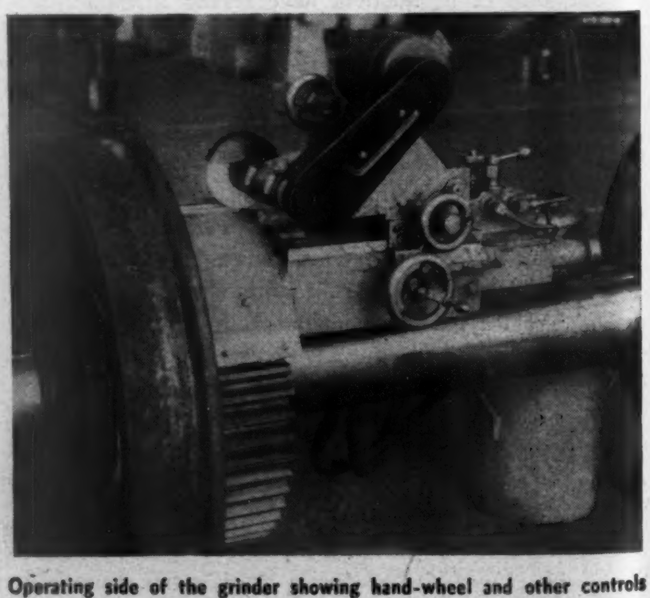
Portable electro-hydraulic gear-tooth grinder developed on the C. B. & Q.

A witness mark is left on each of the gear teeth, thus assuring that no more metal than absolutely necessary has been removed. The ring gear will then mesh smoothly with a new pinion, the only difference being slightly more back lash than when both the gear and pinion are new. The time required for grinding a worn ring gear by this method varies with the gear size and amount of wear, but, for a 52-tooth gear, averages about eight hours. The ring gear does not have to be removed from the axle for this operation, a further important advantage.

One illustration shows the grinder applied over the ring gear on a pair of mounted power-truck wheels which rest on rollers for easy rotation, as required. The 5-in. abrasive wheel is driven by V-belt connection from an elecrtic motor on top of the machine and traversed by hydraulic pressure in a small cylinder built into the base. Hydraulic pressure is supplied by two rubber hose connections from a compact electric-driven pump and oil-storage unit which is shown resting on the floor of the shop.

The grinder unit is accurately positioned on the ring gear and securely held in place by three hand set-screws, as indicated, and close inspection will show an out-board support in the form of a steel finger with adjusting screw which projects downward from the base of the machine and bears on the axle about 16 in. out from the ring gear. This feature permits adjusting the abrasive-wheel cross travel parallel with the axle center line. The small handwheel shown near the electric driving motor takes care of any slight necessary vertical adjustment of the abrasive wheel which is mounted together with the driving motor on an A-frame pivoted at the left end and capable of being raised or lowered by turning the handwheel.

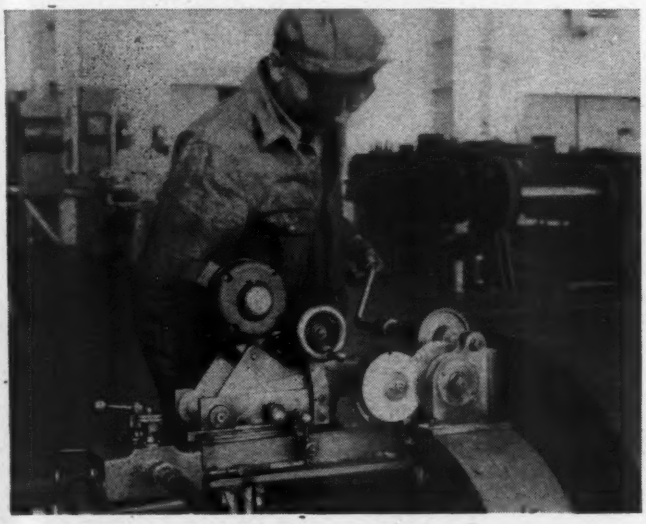
How the grinding machine is positioned with respect to individual gear teeth is also shown in the same illustration. The housing which partially covers the gear teeth carries a small ball-end lever at the lower end which can be used to jack the grinder around the gear, one tooth at a time, as soon as the hand set-screws are released. In other words, after one tooth is ground,



Operating side of the grinder showing hand-wheel and other controls

the set screws are released, the grinder moved circumferencially the required amount and the screws retightened ready for grinding the next tooth.

A second illustration shows the other side of the machine. The grinding wheel and driving motor are supported on a carriage which has limited cross travel by means of the small upper handwheel and longitudinal travel parallel with the axle by the lower handwheel. The latter permits moving the grinding wheel back and forth over the gear tooth by hand to check predetermined travel limits before turning on the hydraulic power drive. The balance of the equipment includes suitable operating valves in the hydraulic pressure



Grinding-wheel-forming tool used to maintatin standard gear-tooth contour

system to give the oil-cylinder piston the desired reciprocating motion, and a number of clamping levers to keep all adjustments of abrasive-wheel position fixed while grinding is in progress.

The third illustration shows a comparatively new means of keeping the abrasive-wheel contour standard as required for accurate shaping of the gear teeth. This is accomplished by use of a hand-operated grinding wheel crusher, or former, which is mounted on the ring-gear guard as shown.

The device consists of two circular steel plates, about 6 in. in diameter, suitably spaced and mounted on roller bearings in a compact housing with 3-to-1 spur-gear drive from the handcrank. The inside faces of the steel plates are machined to the gear-tooth contour and have radial serrations, or grooves, cut as indicated to break down, crush, and remove excess abrasive particles from the grinding wheel. This is what happens when the steel plates are revolved under operation of the hand crank and the grinding wheel (with electric power turned off) is pushed slowly in between the two plates by turning the longitudinal-travel handwheel.

While the grinding wheel is not revolved by the electric motor during this operation, it begins to turn and quickly picks up to the same speed as the steel plates and, in contact with them, soon assumes their exact shape, excess abrasive particles being quickly removed as explained.

The circular steel plates, although made of ordinary carbon steel without special heat treatment, retain their shape and give effective service for a considerable period of time. As compared with a diamond-point tool dresser for shaping abrasive wheels, the device does the work quicker and, in general, more conveniently without removing the wheel from its own spindle.

Air Brake Questions and Answers

The 24 RL Brake Equipment for Diesel-Electric Locomotives—Parts of the Equipment—Locomotive A Unit

D-24 Control Valve (Continued)

631—*Q.—Explain this operation?* A.—One face of the diaphragm is exposed to brake pipe air pressure through a choke, the other face to service slide valve chamber air pressure (auxiliary reservoir). With these pressures substantially equal the diaphragm remains balanced, but if brake pipe pressure exceeds auxiliary reservoir pressure by more than two pounds the diaphragm is deflected, moving follower an unseating valve *150,* which reduces auxiliary reservoir pressure to positively release the brake.

632—*Q.—What is the duty of the release interlock valve portion?* A.—It controls the graduated release and quick recharge features.

633—*Q.—What does it consist of?* A.—A piston pinned to a slide valve by a pin and lock, and held to its seat by a spring through a strut. The slide valve has two positions on its seat between interlock diaphragm and a spring.

634—*Q.—How does the release piston function?* A.—The release piston moves its attached release slide valve in conjunction with spring *120* to control the following —(a) charging of the emergency reservoir in release, (b) charging of the auxiliary reservoir in graduated release and (c) opens and closes the displacement reservoir exhaust in accordance with the position of the service piston.

635—*Q.—What does the strainer* 85 *protect?* A.—The service slide valve and the release interlock valve slide valve from the entrance of dirt.

636—*Q.—What parts does the emergency portion contain?* A.—(a)—emergency piston, (b)—emergency slide valve, (c)—emergency graduating valve, (d)—piston and vent valve, (e)—emergency piston return spring and cage, (f)—emergency piston spring and guide, (g)—high pressure valve, (h)—spill-over check valve and ball check, (i)—accelerated release check valve and ball check, (j)—diaphragm spring and slide valve strut, (k)—the safety valve, (l)—charging choke plug *22,* (m)—the choke in vent piston and choke *63* in the vent valve cylinder cover and (n)—wasp excluder in the emergency exhaust.

637—*Q.—How does the emergency piston function?* A.—The emergency piston with its packing ring moves the graduating valve when a service rate of reduction is made and moves the slide valve when an emergency rate of reduction is created. It also controls charging of the quick action chamber in the pipe bracket.

638—*Q.—What are the functions of the emergency slide and graduating valves?* A.—They move with the piston to establish the required port connections in the various positions.

639—*Q.—How do the piston* 40 *and vent valve* 41 *function?* A.—The vent brake pipe air to atmosphere during an emergency application.

640—*Q.—Explain the purpose of emergency piston return spring and cage.* A.—During release cycles they return the emergency piston from accelerated release to normal release position when quick action chamber pressure recharges to approximately brake pipe pressure.

641—*Q.—How do the emergency piston spring and spring guide function?* A.—They act to stabilize the emergency portion against undesired emergency.

Left: The Canadian Pacific's blast cleaning plant at its Angus shops—The tall center section at the right houses the blast chamber and dust-control equipment—Below: The 126-ft. drying room where snow and moisture is removed from equipment to be blast cleaned

C. P. R. Grit-Blast Cleaning Plant

Last year the Canadian Pacific placed in operation an up-to-date grit-blast cleaning plant at its Angus Shops, Montreal, Que., Canada. Replacing three sand-blast cleaning sheds that were located at the locomotive, passenger and freight-car departments the new facility is used to clean and remove paint from passenger cars, freight cars and locomotive equipment, including miscellaneous units of work equipment and a variety of car, locomotive and structural parts that are brought to the plant in groups or as individual units.

Parts of the locomotives are washed with hot water and cleaning compounds at the plant for removal of accumulated grease and oils. For protection to motion work, running gear and journal bearings, angular steel grit cleaning of these parts is omitted, as abrasive action would impair running condition if any grit particles were not properly removed.

In addition to concentrating the blasting operations for the entire shop at one point, the new plant has other advantages. An important one is the reduction in the health hazard. The previous sand-blasting plants were sheds with open sides and although the operators wore protective clothing and masks, the sand was carried by the wind to unprotected workmen around the shops, creating a health hazard. All blasting is now done in an enclosed blasting chamber in which the operators wear protective clothing and dust-proof masks to which fresh air is delivered from the outside atmosphere in summer months and warm air is supplied from the inside of the main building during winter months by a hygienic air-supply unit. Eighteen outlets in the interior of the blast chamber are suitably arranged for operators' convenience.

All grit-blast hoses are equipped with push-button electric controls located about two feet from the nozzle

Left: Washing a locomotive in the general cleaning section—Above: Many miscellaneous small parts, such as these car steps and stoker ball connection, are shot blasted

Left: The operator on the catwalk at the right is starting to shot blast a tender—Right: This tender tank has been blast cleaned and is awaiting a priming coat in the room adjacent to the blast chamber—Cleaned parts are spray painted before movement into the outside atmosphere to avoid corrosion

outlet where the operator by continuous thumb pressure controls the flow of grit to the work. A release of pressure on the control automatically shut off the nozzle, thus protecting the operator in case of any mishap.

The new plant made possible a reduction in man hours through the consolidation of the blasting operations that reduced the working force and the speeding up of the cleaning operations. The exterior of a box car can be cleaned in two hours when four men are used, including all preparatory work such as covering the trucks with canvas to keep the grit out of the journal boxes and to insure that the grit is not retained on horizontal surfaces. All equipment and material after blasting is blown off with compressed air while the car is still in the blast room and before the equipment is moved to the paint-spraying section. A feature contributing to an improved operation is the installation of a chamber in which all parts can be thoroughly dried before they are blasted. This operation is particularly important at the Angus Shops in the winter because of snow and ice that frequently clings to any piece of equipment unprotected from the weather in that northern climate.

A flexibility in the kind of surface finish produced by the shot blast is afforded in the available types of angular steel grit that can be used. The Canadian Pacific uses a mixture of S.A.E. G-25 and 50 grades for all of its operations. Another advantage over sand blasting is that most of the angular grit is reclaimed with the exception of a small amount lost by disintegration which amounts to approximately two pounds per hour when using ½-in. diameter nozzle at a pressure of 80 lb. per sq. in. Using this pressure and nozzle, the delivery is 28 cu. ft. of grit per hour per nozzle in continuous operation.

Plant Layout

The plant is housed in a new structure divided into three main sections. One side of the building, 60 ft. by 254 ft., is employed as a scrap reclamation shop. The center section, 45 ft. by 254 ft., is where passenger cars and locomotives are given general cleaning and equipment not requiring blast cleaning is removed. The other side of the building has a length of 416 ft. divided into three main rooms. The first is a 20-ft. by 126-ft. drying room, the second is a 28-ft. by 126-ft. priming room where the cleaned steel is spray painted to prevent corrosion. A standard-gauge track is laid in the washing section and another runs through the center of the drying, blasting and priming rooms. Equipment to be blasted is placed in the drying room, if necessary, where a fast drying temperature is maintained by overhead unit heaters. After drying, the car tender or part is hauled into the shot-blast chamber by a cable and car puller.

Blast Chamber and Equipment

The blast-cleaning and dust-control equipment are products of the Pangborn Corporation, Hagerstown, Md. The blast chamber is an enclosed steel room, 20 ft. by 20 ft. by 127 ft. Both ends of the chamber are equipped with 14-ft. 3-in. by 16-ft. 6-in. doors which seal the room during the shot blasting operation and are large enough to allow rolling stock to enter. Two catwalks, along each side, one 7½ ft. and one 15 ft. above the floor, allow the operators to reach any part of a car. The floor is made of 5-16-in. perforated plate, the holes permitting the used shot to drop into a hopper extending the entire length of the room underneath the floor.

The used shot slides from the hopper onto two 14-in. conveyor belts which travel from each end to the center

The steel enclosed blast chamber illuminated by 148—200-watt lights enclosed in special Pyrex fixtures

of the chamber. Each conveyor belt will handle 24 cu. in. of grit per foot of belt. At the center, these two conveyor dump the shot into a transverse conveyor that carries it to a bucket type elevator lifting the shot to an abrasive separator where dust and fine particles are removed. From the separator the shot is returned to the pressure blasting machine for reuse.

During the shot blasting the dust-laden air from the operation is drawn by a fan through a collector located over one end of the chamber, which has 1,140 screens with 16,640 sq. ft. of cloth area. The dust is separated from the air and then dropped into hoppers under the screens and is carried by a screw conveyor to an exhauster which directly unloads to refuse bin or car adjacent to building. The dust collector fan is driven by a 60-hp. motor and is rated at 47,300 cu. ft. per min.

Four blast-hose outlets, two on each side of the chamber, are equipped with 1½-in. I. D. hose having ½-in nozzles. Each nozzle in the blasting operation is rated at approximately 10 sq. ft. per minute of cleaning area.

A special feature installed in the blast room is a vent pipe with a circular hood which can be readily attached to smoke-box fronts of boilers requiring internal cleaning. This unit is controlled by push buttons operating a 3-hp. hoisting motor which allows the vent to be elevated above the clearance height of equipment passing through the blast room for regular cleaning.

After cleaning, the equipment is run into the priming room where a primer coat is spray painted before the cleaned surfaces can be corroded by the atmosphere.

Questions and Answers On Locomotive Practice

By George M. Davies

(This column will answer the questions of our readers on any phase of locomotive construction, shop repairs, or terminal handling, except those pertaining to the boiler. Questions should bear the name and address of the writer, whose identity will not be disclosed without permission to do so.)

Lubricating Main Pins

Q.—We are changing some of our Mikado type locomotives by applying hard grease lubrication to the main crank pins. It has been suggested that we drive in steel plugs at each end of the hollow bore and secure them with a bead of weld, tapping the outside plug for the Alemite fitting. Would there be any objection to this procedure?—K.L.F.

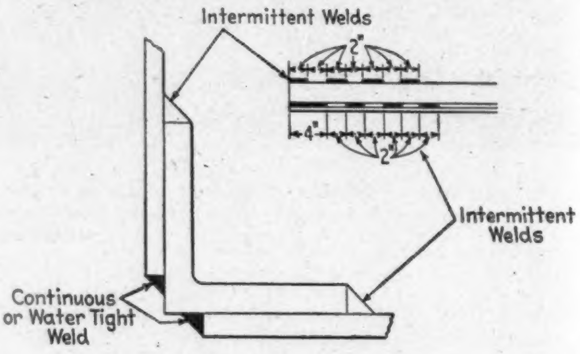
A.—The general practice in converting hollow-bored main crank pins for hard grease lubrication is to tap the hollow bore and apply a threaded plug at each end, applying a bead of weld around the circumference of the plug.

A threaded plug is more desirable because the plug is not dependent upon the weld to hold it in place. An overheated pin would cause the driven plug to loosen. Also, considerable pressure can be built up on the plugs when applying grease to a pin having the grease holes plugged. A threaded plug is less liable to be lost before detection than a plug that is not threaded. When applying an Alemite grease plug to the end of a main crank pin it is the general practice to counterbore the end of the pin before applying the plug. The counterbore is made deep enough so that the end of the Alemite will be flush with the outside of the pin, thus protecting it from being knocked off.

Welded Tender Tanks

Q.—In changing from riveted to welded tank construction, where the side sheets are connected to the top and bottom plates with a 2½-in. by 2½-in. by ⅜-in. angle, would a ¼-in. fillet weld along the outside edge of the plates provide sufficient strength for this connection?—E.J.F.

A.—The strength of welded connections used in place of present riveted construction should be at least equal



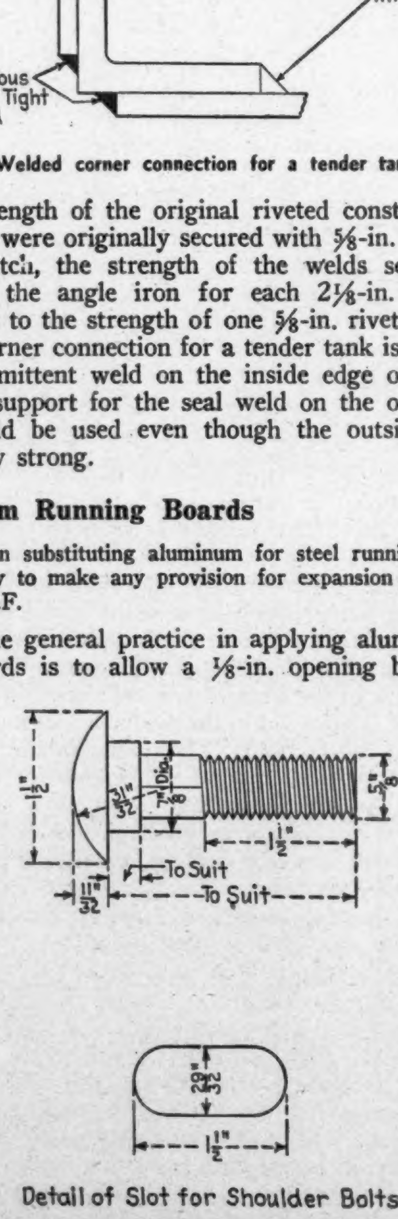
Welded corner connection for a tender tank

to the strength of the original riveted construction. If the plates were originally secured with ⅝-in. rivets with 2⅛-in. pitch, the strength of the welds securing the plates to the angle iron for each 2⅛-in. should be equivalent to the strength of one ⅝-in. rivet. A typical welded corner connection for a tender tank is illustrated. The intermittent weld on the inside edge of the angle provides support for the seal weld on the outside edge and should be used even though the outside weld is sufficiently strong.

Aluminum Running Boards

Q.—When substituting aluminum for steel running boards is it necessary to make any provision for expansion and contraction?—K.L.F.

A.—The general practice in applying aluminum running boards is to allow a ⅛-in. opening between the



Shoulder bolt and slot for aluminum running boards

ends of the plates when the locomotive is cold. Slotted running boards and button-head shoulder bolts, as shown in the illustration, are used to hold the boards to the brackets. The slotted holes allow for the expansion of the boiler without affecting the alignment of the running boards. The large button head provides an ample hold-

ing surface and reduces the wear of the head in the aluminum plate. The depth of the shoulder on the bolt is made 1/16 in. greater than the thickness of the run-board, thus allowing for a free movement of the run-board. When applying aluminum running boards with steel bolts to steel or iron brackets the aluminum plate and the holes in the plate should be painted where they come in contact with the brackets and bolts.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Repairing Pitted Courses

Q.—The shell courses of our Pacifics are pitted to such an extent that they need repairs. Should the pitted sections be removed and part of a new shell course applied or should patches be applied? If patches are used should they be on the inside or outside?—R.E.V.

A.—Most pitted conditions are repaired by applying patches on the outside of the shell, this repair being more economical than the application of new bottom sections. However, the extent of the pitted area generally governs which type of repair should be made. Inside liners are sometimes used where a pitted condition exists along the bottom of the back shell course and the outside throat sheet. This eliminates the necessity of opening up the circumferential seam between the shell course and outside throat sheet to apply an outside patch. With this arrangement the throat-sheet braces are riveted to the liner and shell and set to suit the additional thickness of liner.

Effect of Arch On Cinder Cutting

Q.—What effect does the location and the height of the arch have on cinder cutting?—H.F.

A.—Cinder cutting of sheets and flues is caused by the action of high-velocity gases containing ash and small particles of unburned fuel, the unburned fuel causing practically all of the cutting. The cutting of the crown sheet, syphons, and staybolt heads can be reduced by shortening the arch, and thus providing a larger area over the arch through which the gases can escape. However, this shortening of the arch causes an increase in the amount of fuel used. Deflecting brick can be used in the top row of the arch which will tend to throw the gases against the door sheet, giving them longer travel and burning the fuel more completely. When these gases pass over or near the door sheet they give up a portion of their heat, thus reducing the volume of the gases passing between the arch and crown sheet as well as more completely burning the fuel. A well-designed firebox provides not less than 16 to 18 in. between the grates and the arch. The gas opening between the back end of the arch and the firebox door sheet should not be less than the total gas area through the flues and tubes. The opening above the arch should be 115 per cent of the flue and tube gas area.

Comparative Distortion of Single- and Double-Vee Welds

Q.—When butt welding plates together, which type of weld gives the least amount of distortion in the plate, the single-vee or the double-vee weld?—M.K.R.

A.—The double-vee gives the least amount of distortion in the plate; with a plate of the same thickness the width of the groove will be less for a double-vee weld, keeping the distortion in the sheet to a minimum. When welding the joint from opposite sides of the plate, as with the double-vee weld, the weld on the one side of the plate tends to reduce the distortion caused by the weld on the opposite side.

Fig. 1 *A* shows a single-vee butt weld before welding. The plates are as shown and are first fastened for welding by means of tack welds. The welder then starts his

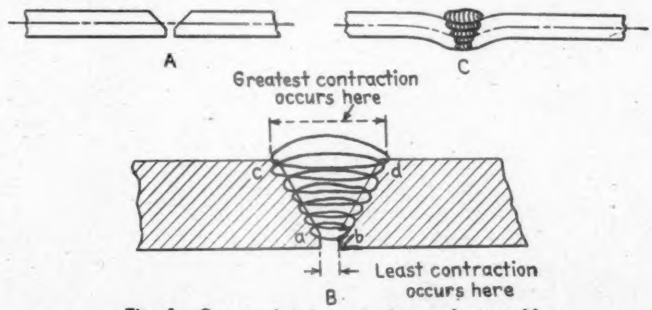


Fig. 1—Contraction in a single-vee butt weld

first bead at the narrow part of the vee as shown at *a-b*, Fig. 1*B*. With successive beads the welder builds up the joint to *c-d*. The lower part of the weld at *a-b* has a small amount of contraction since the amount of weld metal at that spot is small, being in the narrowest part of the groove. As the weld grows higher, the groove gets wider, and the longitudinal contraction of the plates across the weld is therefore greater. Owing to the greater contraction of the top of the weld, the top surface of the plates will be shorter than the bottom surface. This will cause the plates to be dished locally as shown in Fig. 1*C*. The backing bead, which is put on underneath after the heavy part of the weld is finished, is not large enough to reduce the distortion of the joint appreciably.

In the double-vee butt joint the distortion is less than in the single-vee joint. Here half of the weld is inside

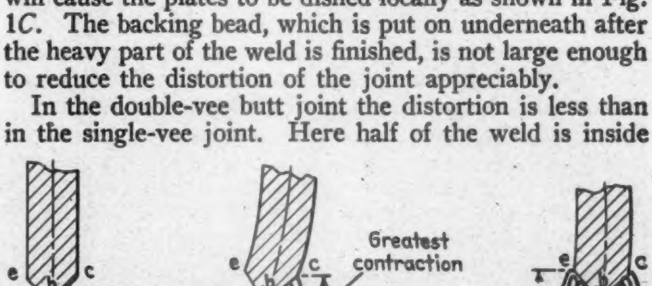


Fig. 2—Distortion in a double-vee butt weld

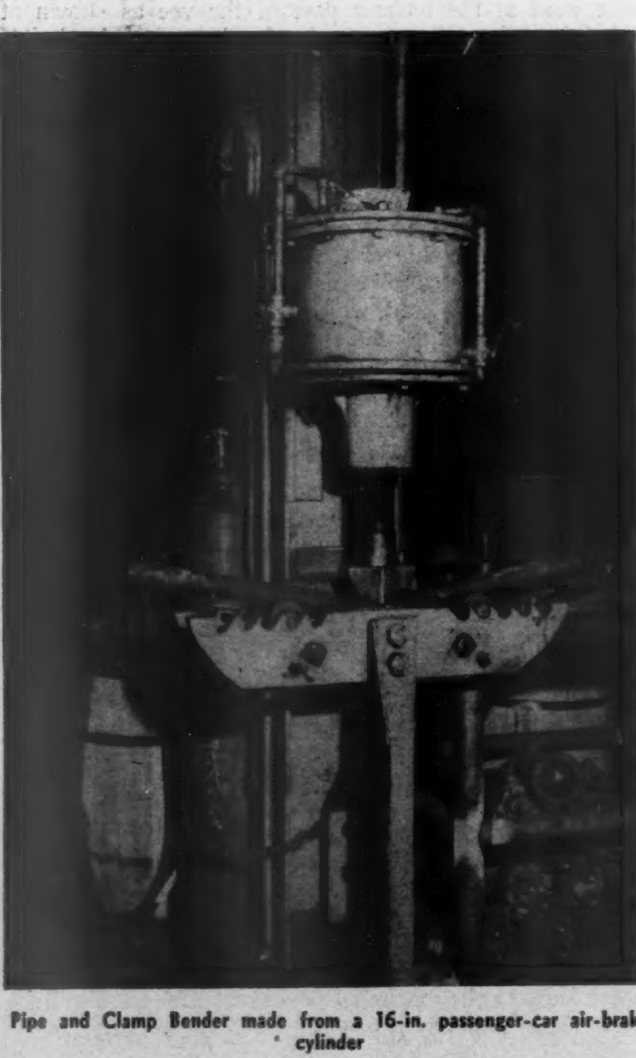
and half is outside. Before welding, the plates are as shown in Fig. 2*A*. The one side, *"abcd"*, of the joint is welded and the distortion is as shown in Fig. 2 *B*. When the other side, *abef*, is welded the contraction at *ef* will tend to straighten the joint; but because the other side is restrained by the first weld, the plates will not quite come back to their original position. The joint will remain slightly distorted as shown in Fig. 2*C*.

With the Car Foremen and Inspectors

Pipe and Clamp Bender

Effective use of a 16-in. passenger-car air-brake cylinder is made at the passenger-car shop of the Chicago, Rock Island & Pacific at 47th street, Chicago. All commonly used sizes of pipe as well as clamps and other miscellaneous articles to be bent are easily and quickly shaped to size on this device fabricated by shop forces.

The work piece is supported on blocks or rollers which fit into notches on the base. Five of these notches are in each end of the two members that form the work support and support the piece to be bent at the desired points for the particular bend that is to be put in the work. Bending operations are performed by attaching a siutable die to the piston rod and opening the air-admission valve to the cylinder. After the air pressure has foced the piston down far enough to form the work piece to the shape desired, the inlet is closed and the exhaust valve opened. This exhausts the air from the cylinder, permitting the piston to be returned to its original position by means of the spring mounted underneath the piston. Close control of the bending operation is obtained by either throttling the inlet valve or cracking the exhaust valve, or both. If the workman desires to check the shape of the piece being formed, he can close the inlet valve and leave the exhaust valve closed at the same time, thereby retaining the piston in its last position. Pipes, clamps, and other articles to be shaped can be bent anywhere up to a right angle or to a complete U-bend with the appropriate die.



Pipe and Clamp Bender made from a 16-in. passenger-car air-brake cylinder

The cylinder is mounted on a 12-in. I-beam sunk 5 ft. into the foundation ground of the building. A section is cut out of this I-beam to accommodate a steel plate, ⅞ in. by 12 in. by 16 in., which is welded to the beam. The cylinder is bolted to this plate. The two air connections to the cylinder, one for air inlet and the other for exhaust, consist of ½-in. pipe threaded into the top of a cylinder.

The inner member of the notched base which holds the work piece during the bending operation is bolted to the I-beam through about 8 in. of filler plates. The outside member of this supporting base is held to the inner member by two long bolts. It is supported by being bolted to a length of angle iron, 4 in. by 4 in. by ½ in., which slopes downward and inward toward the I-beam and is bolted to the I-beam at the bottom. Further support is furnished by a vertically mounted angle which rests on a floor-mounted plate, 6 in. by 6 in. by ½ in.

Portable Scaffold

The safety and flexibility of permanent scaffolding are found in a portable scaffold designed and built by the shop forces at the 47th-street, Chicago, passenger-car shops of the Chicago, Rock Island & Pacific. Safety is attained by a feature which locks the scaffold in place and flexibility is provided by locating the platform supports at intervals of one foot from distances of three to nine feet above the shop floor. At the same time portability eliminates the interference to working or to moving materials and replacement parts that would result from supports for permanent scaffolding.

The portable scaffold is 48 in. wide by 12 ft. long at the base and has a height to the top platform support of 106 in. The top is 30 in. wide by 12 ft. long and supports a wooden platform with a width of 25 in. The longitudinal edge of the upper platform support that is next to the car when the scaffold is in use is directly above the equivalent edge of the scaffold base. The ladder slopes the 18-in. difference in width between the base and the upper platform, the slope of the ladder giving added stability and greater ease of climbing. Additional safety in ascending the ladder is furnished by a hand rail fastened to the top platform support at the right of the ladder.

For movement around the shop the scaffold is mounted on four 6-in. wheels, each of which swivels a full 360 deg. around a vertical axis. When in use the scaffold is raised so that one pair of wheels clears the

A scaffold built by Rock Island shop forces is easily transported and is locked in place for safety

floor and the scaffold rests on the bottom of the bend on two lengths of 1-in. round iron stock formed to a J-shape. One of these J-shaped supports is welded to each end of a pivot bar which pivots 90 deg. in holes in a fitting bolted to a plate below the main bottom support along one short-dimension side of the base. The support is locked in the horizontal position when the scaffold is being moved about the shop, and in the vertical position when supporting the scaffold. In either position the support is locked in place with locking pins.

The scaffold in use at the present time is constructed from angle irons, ¼ in. by 2 in. by 2 in., riveted together, while future ones to be built will be mainly welded. The bottom base is strengthened by a ¼-in. plate at each corner, by an angle-iron cross brace, and by a section of angle iron that joins each of the lengthwise members of the base at the center and slopes downward toward the bottom of the vertical support under the base. The top base is trussed with five ⅜-in. rods running the length of the scaffold. The horizontal hand rail and the six vertical uprights that form the guard rail at the top are fabricated from 1-in. pipe which is welded in place.

The hand rail to the right of the top of the ladder is formed from ⅝-in. round iron stock to give a clear holding length of 18 in. It is bolted on the angle iron of the upper platform support. The ladder rungs are made up of ¾-in. pipe in 15-in. lengths mounted 1 ft. apart. The rungs are secured in place by bolts extending through the pipes from one end to the other. One end of each bolt rests in holes drilled through the end vertical angle iron support and the other end in an extra length of the angle iron riveted in its vertical position for the purpose of securing the rung bolts in place. The rung bolts serve also to fasten one end of the horizontal angle-iron braces for the platform at the ladder end.

Overhead Welding Rail

Spot welding is made appreciably easier at the Chicago, Rock Island & Pacific 47th-street, Chicago, passenger-car shops, by the manner of suspending and carrying the spot-welding apparatus. The spot welder is held in a rope sling carried by the hook of a ½-ton chain hoist.

The chain hoist is suspended from a 8-in. I-beam which serves as a traveling rail and on which the hoist, carried by a four-wheel truck, moves transversely with respect to the car being repaired. The traveling rail, in turn, is suspended from a 10-in. I-beam. It travels on four-wheel trucks, two of which are mounted on each end of the traveling rail. These two trucks on each side, four altogether, move longitudinally with respect to the car under repair. The 10-in. I-beam extends nearly the entire length of the shop and is set out about 3 ft. beyond each side of the passenger car. The overall shape of this I-beam is that of an oval to prevent the trucks which carry the traveling rail from overrunning the end.

Both time and back-straining labor are saved by the easy movement in any direction of the spot welder supported through a traveling rail on an overhead-mounted I-beam

All movements, vertical, transverse and longitudinal, are made by hand because the average movement of the spot welder is only about 1 in. in the car exterior work performed with the aid of this suspension system.

Steam Connector Maintenance Tools

An article on pages 700 and 701 of the December, 1947, *Railway Mechanical Engineer* describes the results secured at the Chicago car shops of the Chicago & North Western in setting up an organized program and necessary shop space, tools, and equipment for adequate maintenance of flexible metallic steam-heat connectors of both the Barco and Vapor types. Some additional tools and gauges required with the latter are described in the following paragraphs, the photographs for which were supplied through the courtesy of the manufacturer.

Fig. 1—Dismantling coupler Y-casting with coupler attached

Fig. 2—Gauging a coupler arm for amount of wear

Fig. 3—Method of gauging the wear on a coupler arm

The connector is first placed in the dismantling jig on the shop bench, as illustrated in the previous article. The large parts are removed and put in movable bins, while smaller parts go in boxes on the bench. In Fig. 1, a coupler adapter or Y-casting, with the coupler attached, is being removed from the conduit. This is the first step in the maintenance program.

In order to disconnect this casting, it is necessary to remove the two cap screws. Rusty screws are loosened by penetrating oil, previously applied. A 5/8-in. socket wrench is used to remove the cap screws. The extension on the wrench should be long enough to extend above the spring-support clamp, as illustrated.

After the casting has been removed, it is carefully inspected, a gauge, shown in Fig. 2, being used to check the amount of wear on the arm of the coupler. If the coupler arm is battered or badly distorted, it is discarded. If worn below a minimum permissible height, it is built up and machined to the proper size.

While the coupler is being inspected, the cam also is checked with the gauge shown in Fig. 3. This gauging should be done accurately as the cam is part of the locking mechanism which guards against a loss of steam between couplers.

When checking the height of the nose of the coupler adapter body, a gauge is used which allows a maximum wear of .062 in. If the nose is worn beyond this point, the casting is scrapped or built up by welding and remachined to the specifications of a new casting. The diameter of the nose of the Y-casting is allowed a maximum wear of .030 in.

On the main or intermediate D-body casting, H-clamps are used to hold the upper joint body and the lower joint body in place. These are removed as shown in Fig. 4. The workman is using an air-impact wrench with a socket cap to remove the screws which hold the clamp in place. A regular socket wrench may also be used to remove these screws. The upper joint B-body casting is also removed from the conduit for inspection by removing the upper joint body clamp which holds it in place.

One vital requirement in maintaining for flexible metallic conduits is replacing gaskets throughout the units. In order to prevent leakage of steam, each gasket has a spring to follow up the gasket wear and to maintain a tight joint. These springs are periodically removed and checked, those compressed to less than 1 1/8 in. free height being discarded. Gasket ferrules which

Fig. 4—How the intermediate body H-clamps are removed

Fig. 5—Equipment for gauging the clamp bearing housing

become bent or distorted are straightened and gauged.

One important step in checking clamps is illustrated in Fig. 5, which shows how the surfaces of the bearing housing must be gauged and the clamps checked for alignment. If the clamps are out of line, they may be straightened cold by using a straightening device.

The surface of the housing may be machined if it is not badly worn and shim washers used to take up play. Housings showing excessive or uneven wear are scrapped. In the illustration, the jig used for holding the bearing housing during this gauging operation has been elevated from the bench for better observation.

In Fig. 6, the gaskets and springs from the main body or D-casting are being removed for inspection. For this operation the casting is placed in a bench jig which has been designed to hold it securely. Several methods are used to remove these gaskets. One way is to soak the gaskets with penetrating oil and then remove them with a pull rod made for this purpose. Another way to get the gaskets out is the method, illustrated, which calls for a special gasket removing tool. New gaskets are used throughout in reconditioning conduits.

One of the most common ways of removing the bushing from the D-body casting is the application of a torch to the bushing, on a direct line with the bracket portion of the casting. The excess metal at this point prevents damage to the casting and the bushing can be knocked out by hammering the clamp bracket against a heavy block.

Bushings which have been gauged as satisfactory are cleaned with emery cloth and machine oil, as the smoother the bushing is kept, the less the tendency of the gasket to stick. The way in which bushings are cleaned at the C. & N. W. shop is shown in Fig. 7. Here the workman has fastened the emery cloth to a power tool to speed up the job of cleaning.

Before the reconditioned parts of the main or intermediate body castings are assembled, new bushings are pressed into place if needed. This is accomplished with the aid of a shop-made hydraulic press with the work table elevated to a convenient height.

As a first step in reassembling the conduit, the upper joint body casting and the end valve connector are put together. A solution of eight parts of steam cylinder oil to one part of graphite is used to lubricate the gaskets. Fig. 8 shows a workman using a power tool to tighten the cap screws in assembling a conduit. The work has been simplified by placing the unit in a bench jig and adding the parts one at a time. Precaution is taken to make sure that there is no binding of any of the parts as the conduit is being assembled. On completion of assembly work, the steam connector is tested under pressure and motion simulating service conditions in a special testing device shown in the article in the December issue.

Fig. 6—Removing gaskets and springs from the body D-casting

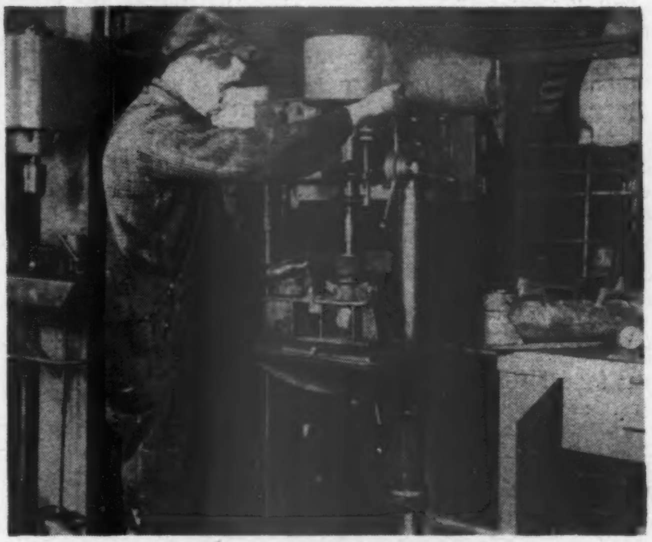


Fig. 7—Method of cleaning and polishing the bushings

Fig. 8—Jig and equipment used in assembling connectors

Guard for Electrical Outlet

Prevention of damage to electrical outlet boxes from various shop trucks and other means of inter-shop transportation is attained at the 47th-street, Chicago, shops of the Chicago, Rock Island & Pacific by means of a simple guard fabricated in the shop. The guard protects cast-aluminum multiple-outlet boxes which furnish the three most commonly used voltages in shop work.

The guards are made from ⅜-in.-thick steel plate and 1¼-in. pipe welded together. The plate is made in two halves, each 16 in. by 14 in. From each of these halves a rectangular section is burned out, the size of the opening being such that when the two plates are fitted together the resulting opening will enable the plates to fit around the sides of the outlet where it emerges from the floor. After the openings have been cut out from the two halves of the plate, they are fitted around the electrical outlet and welded together in place. A length of 1¼-in. pipe which has been bent to a U-shape is then welded to each end of the steel plate. The pipe, after being bent to the U-shape and welded in place, is 6 or 8 in. higher than the top of the outlet. It extends about 3 in. beyond each side of the outlet and 3 in. beyond the end extremity of the outlet.

The electrical outlets which the guards protect are located in pairs at each end of the car. Each outlet has four 110-volt sockets for drills, lights, sanders, grinders, etc.; one 220-volt socket for portable battery chargers, and one 440-volt socket for electric welders. By locating the outlets in pairs at each end of the car, extension lines are kept at a minimum length. An adequate number of electrical connections are provided by the availability of sixteen 110-volt lines, four 220-volt lines, and four 440-volt lines.

Guard for protecting electrical outlet is fabricated by welding together two ⅜-in. steel plates and two lengths of 1¼-in. pipe bent to a U-shape

* * *

A 50-ton aluminum box car which has been placed in test operation on the Chesapeake & Ohio. The car, one of 10 built at the Russell, Ky., shops, is 40 ft. 6 in. in length and weighs 36,400 lb.

ELECTRICAL SECTION

A. C. Air Conditioning*

By H. H. Hanft†

Engine-powered system tested on C. M. St. P. & P. in 1946 and 1947 has been redesigned and is ready for reapplication

Most passenger cars now on order will carry d.c. electro-mechanical air cooling systems. Such equipments are powered at standstill, and at low train speeds, by 32-, 64-, or 110-volt storage batteries. At normal running speeds, refrigerant compressor motors draw current from axle-driven generators, which also serve to charge the storage batteries.

When the trend toward light-weight passenger cars became firmly established, designers concentrated first on weight reduction in car body structural members and shell, and in trucks. They soon became aware that increasing car electrical loads had raised the total weight of electrical accessories and other fittings to approximately 30 per cent of the total dry car weight.

An analysis of designs revealed that storage batteries alone weighed from 4,800 to 9,500 lb. Axle generators and drives added 2,500 lb., and cable and conduit in the lower voltage systems totalled another 2,500 lb.

Further study suggested a change to an a.c. system, which could reduce battery weight to a minimum, would eliminate the d.c. axle-driven generator, and through use of a higher voltage, would reduce materially the size and weight of electric cable and conduit.

Such a.c. equipments have been built and operated. Refined designs are in operation, or on test. All of them require a source of a.c. power. Several power supply systems are available.

Alternating Current Power Supply

Power may be generated either on each individual passenger car in a train, or at the head end of the train. Head-end power may be generated by a steam turbine or Diesel-engine generator, carried in a power car at the head end of the train, or on the locomotive tender or locomotive. Head-end power offers advantages, especially from the maintenance point of view, when interchange of cars is not a problem. When each individual car must carry its own source of power, under-car generators, driven by Diesel or gas engines, are available.

Power generated at the head end of the train is transmitted throughout the length of the train by train-line cables permanently installed in conduit on each car. The gap between cars is bridged by train-line jumpers and car receptacles. Three phase power is generated for transmission at relatively high voltage, and is transformed to 220 or 110 volts for utilization on each car. Control interlocking prevents the electrical load on all cars from being applied simultaneously.

Under-car engine generators are governed to maintain speed and frequency regulation suitable for satisfactory operation of fluorescent lighting, despite the sudden load changes which occur when compressor and fan motors are started. Generator excitation may be supplied by a rotating exciter, or by rectifiers. The latter

* Abstract of a paper presented before the Winter Meeting of the American Institute of Electrical Engineers held in Pittsburgh, Pa., January 26-30, 1948.

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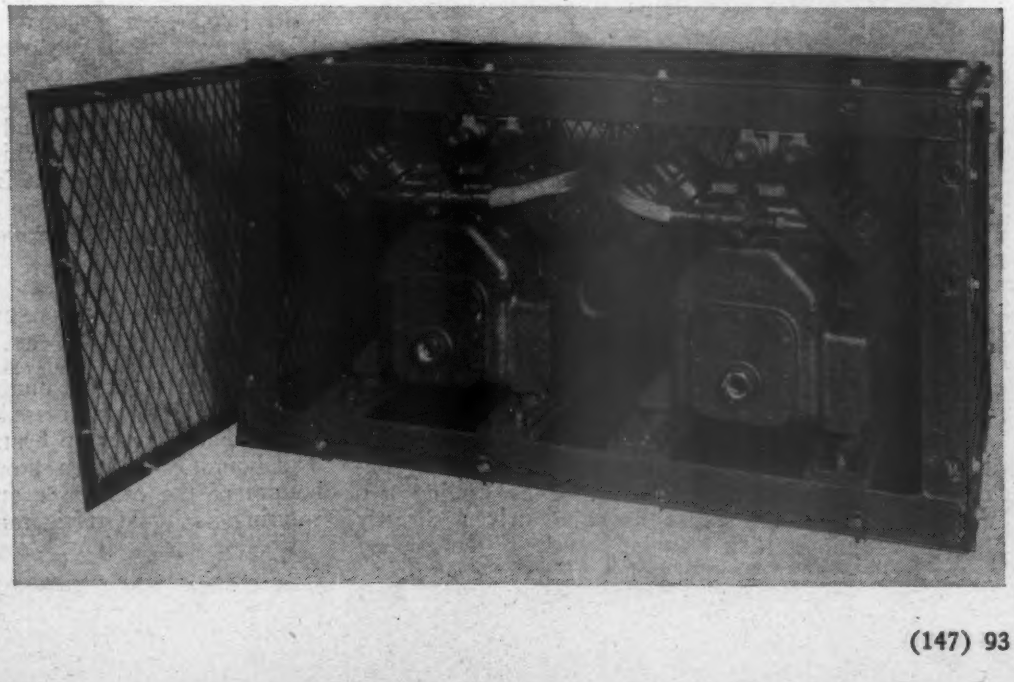
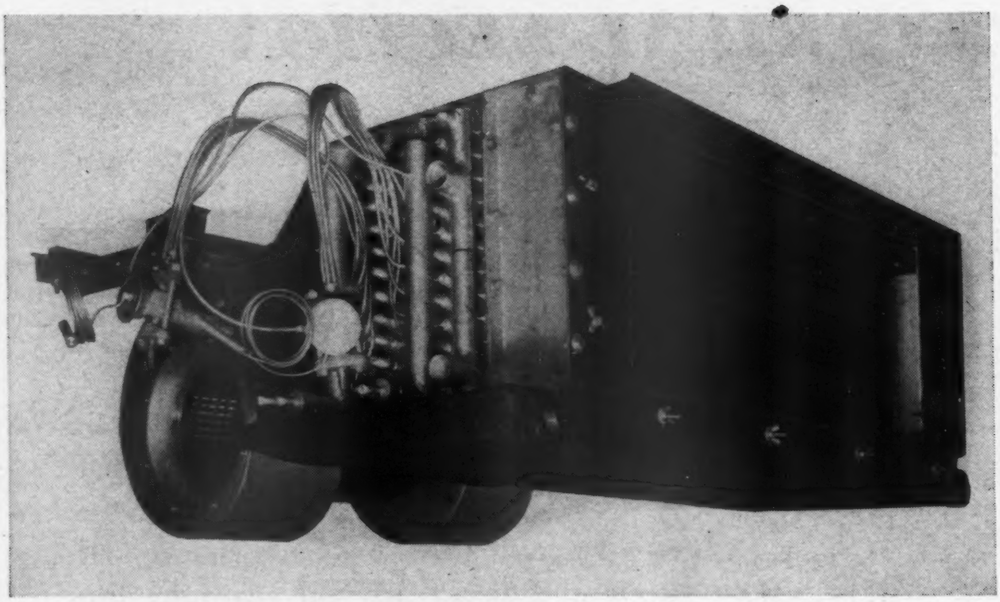


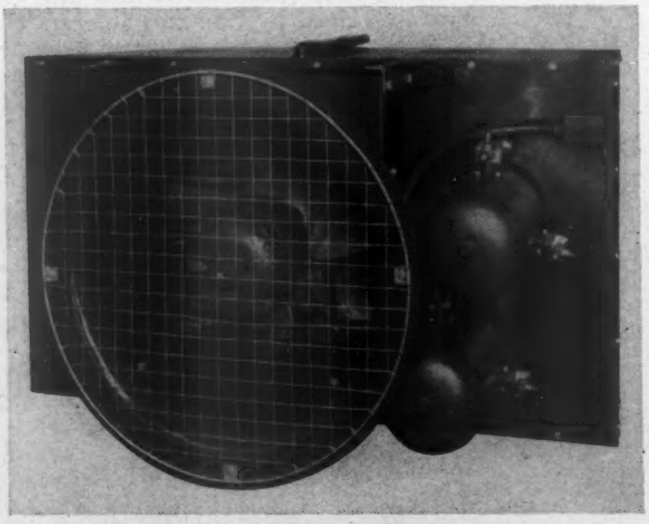
Five-horsepower, hermetically-sealed air conditioning compressors



Overhead evaporator unit, showing dual blowers and finned electric strip heaters at discharge end

scheme involves no moving parts and is extremely rapid in its response to sudden fluctuations in load. With rectifier excitation, the generator is dually excited. One field provides no-load excitation, drawing current from a small emergency car-lighting battery. The second field is excited through a rectifier served by current transformers connected in the generator output leads. Varying with generator load, this secondary field provides the equivalent of flat compounding in a d.c. generator.

Alternating-current power, whether head-end or car-generated, is used to drive refrigerant compressors, car air fans, condenser fans, exhaust fans, sleeping room fans,



Condenser, showing fan and liquid receivers

and water coolers, and supplies utility outlets and fluorescent lighting circuits, without need of a rotating conversion device or vibrator inverter. The maximum electrical load on an a.c. powered, modern passenger car exceeds 20.0 kilowatts.

Alternating Current Air Conditioning System

Alternating current cooling equipments vary greatly in detail. Refrigerating capacity may be varied by unloading a single large compressor, or by cycling two smaller units. Compressors may be driven directly through couplings, they may be belted, or the driving motor may be hermetically sealed into the compressor crankcase. The number of control combinations possible for use in regulating temperature and humidity of air in the passenger space is virtually unlimited. Humidity control, itself, may be accomplished in a number of basically different ways. Either steam coils or electric heaters may be used in the overhead cooling unit to reheat air which has been sub-cooled to remove excess moisture, and to heat ventilating air brought into the car in cold weather.

In the interest of simplicity, the following description is restricted to a single complete refrigerating system, which is to be placed in service at the start of the coming cooling season. Component parts include:

1. Compressor package
2. Condenser package
3. Evaporator package
4. Electric contactor panel
5. Under-car control package
6. Control stations

Compressor Package

The enclosed compressor compartment is carried under the car. It contains two hermetically-sealed compressors having a total cooling capacity of from 8 to 9 tons. Each compressor is driven by a 5-hp., 3-phase, 60-cycle, 220-volt, 1,750 r.p.m., squirrel-cage induction motor. Refrigerant vapor passing over motor rotor and windings cools the motor. The compressors are charged with refrigerant and lubricant at the factory, and then they are sealed. Flexible suction and discharge tubes terminate in flanged shut-off valves which mate with similar valves fixed to the compartment framework. Compressors are removed from the package for servicing, by closing the shut-off valves, and breaking the valve flanges with little loss of refrigerant.

Condenser Package

The condenser, of conventional finned copper tube construction, is carried under the car in a separate compartment. Hot, compressed refrigerant vapor entering the condenser gives up heat, condensing to liquid form. The liquid Freon then flows to a sub-cooler near the bottom of the condenser and is further cooled before entering its liquid refrigerant receiver.

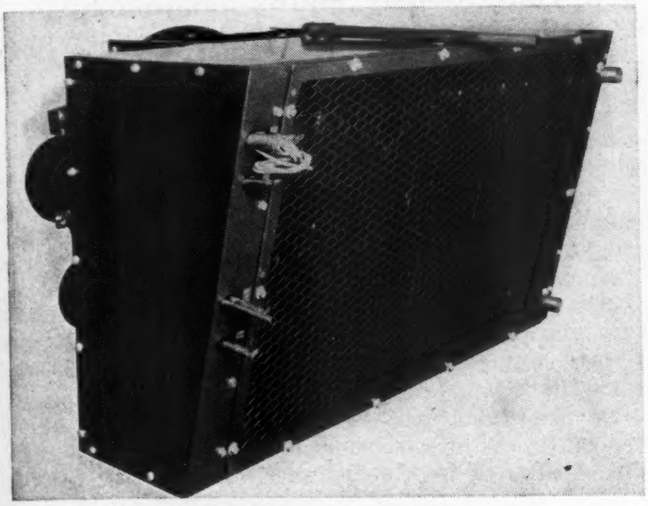
Cooling air is forced over the condenser and sub-cooler coils at 770 lineal ft. per min. by a 1,750 r.p.m.,

axial-flow fan, driven by a 1.5-hp., 3-phase, induction motor. In hot weather, atomizing nozzles spray water over the condenser coils at the rate of 120 lb. per hr. Water entering the nozzles comes from the car water supply under air pressure

All condensate from the evaporator drain pan is introduced into the condenser cooling air stream, reducing head pressures by evaporative cooling, regardless of spray nozzle operation. Liquid refrigerant receivers are valved for servicing.

Evaporator Package

The evaporator package is mounted overhead in the car, and consists of a blower unit, an evaporator, and an



Condenser, showing condensate drain pipe at top

electric strip heater assembly. Methods of cleaning ventilating air, and air recirculated from the passenger space, are optional.

Two blowers, each delivering 1,200 cu. ft. of air per min., are mounted on shaft extensions of a 1-hp., 1,150-r.p.m., 3-phase, 60-cycle, squirrel-cage motor. They draw 800 cu. ft. of ventilating air through a grille in the car vestibule, combine it with 1,600 cu. ft. of recirculated air from the car, and force this air through the evaporator and heating section and on out into the passenger space.

The evaporator is of conventional finned copper tube construction. Freon vaporizing in the evaporator chills its surfaces. Warm air passing over the chilled surfaces gives up part of its heat in the evaporator and then enters the passenger space at a comfortable temperature. The heat given up to the evaporator surface then enters the Freon, and is removed after compression, in the condenser.

The electric heating section in the overhead package consists of 18.0 kw. of finned strip heaters, delta-connected in the 220-volt, a.c. power circuit. In cold weather, this electric heat warms the cold ventilating air brought in from the vestibule. On moderately warm days of high relative humidity, the electric heaters raise the temperature of air which has been sub-cooled to remove excess moisture.

The refrigerant compressors and heating section are interlocked to prevent their operation when the car air blowers are not running.

Electric Contractor Panel

The air conditioning power control panel is mounted in the car body. Occupying a space 36-in. high by 16 in. wide, it carries 3-pole, 220-volt contactors, and associated overload relays, controlling driving motors for compressors, car air fans, condenser fan, and electric strip heaters. The overall depth of the panel, including contactor arc chutes and back panel studs, is less than five inches.

Operation of the several contactors is under control of heating and cooling thermostats sensitive to temperatures both inside and outside the car.

Under-Car Control Package

Located under the car is a force-ventilated control box, containing a selenium battery-charging rectifier, and a saturable core reactor which controls the voltage applied to the overhead electric heating elements.

On cars carrying individual engine generators, the under-car control box also houses the rectifier unit used to excite the second, or auxiliary generator field.

Control Stations

Operation of the air cooling equipment is controlled by two master thermostats. Temperature of the air in the passenger space is controlled by a thermostat located within the car. No manual changeover from heating to cooling is required. As temperature in the car tends to rise above the thermostat setting, the number 1 compressor starts and runs until temperature equilibrium is established. If additional cooling is required, the second compressor starts and cycles off and on to maintain car temperatures. If the car air temperature falls below the thermostat setting, electric overhead heat comes on, and is modulated to maintain desired temperatures.

The second master thermostat responds to outdoor temperatures, and serves to reduce excessive humidity in the car on cool, humid days, without need for recourse to controls actuated by the moisture content of the car air. At outdoor temperatures below 60 deg. F., the relative humidity of saturated outside air is reduced to a comfortable level in the passenger space by the action of the car heating system in raising the dry-bulb temperature of the air in the car. Between 60 and 75 deg. outside temperature, the elevation of the dry-bulb temperature may not be sufficient to control excessive moisture in the car air. Some refrigeration is needed to remove moisture from the air.

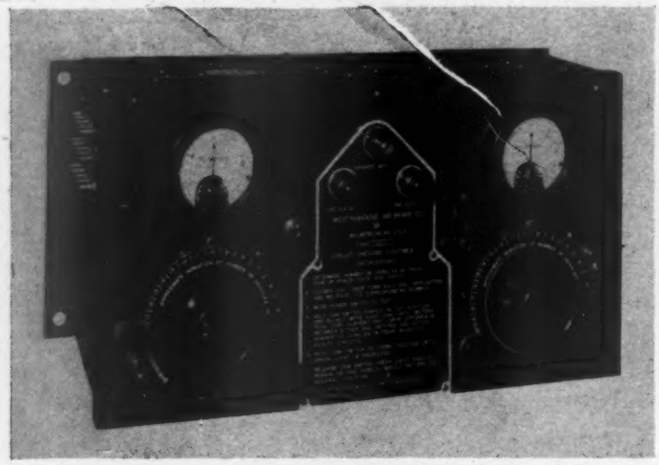
When the outdoor temperature rises to 60 deg., the outdoor thermostat starts the number 1 refrigerant compressor, which then runs continuously as long as outdoor temperature remains above 60 deg. Excess moisture in the car air stream condenses ventilating and recirculated air leaves the evaporator too cold for passenger comfort. The indoor master thermostat then calls for overhead electric reheat sufficient to raise evaporator discharge air temperatures to the comfort point.

As outdoor temperatures rise from 60 deg., the amount of electric reheat requires decreases, until a temperature is reached at which no reheat is required. At this point, any further increase in outdoor temperature causes the indoor thermostat to demand more cooling. The thermostat then starts the number 2 refrigerant compressor, which cycles on and off with the inside car thermostat demand. As the outdoor temperature and car load increase, the "on" periods lengthen, until both compressors run continuously.

The two master thermostats operate independently of floor heat controls to maintain both temperature and moisture content of the car air stream within the comfort zone at all times.

(*Continued on page 154*)

Checker for High-Speed Brakes*



Relay Cabinet

By C. M. Hines†

Arrangement consisting of two Wheatstone bridges, with rugged relays replacing galvanometers, continuously shows engineman the condition of brake circuits

SINCE 1933, most high speed trains (running at speeds in excess of 75 m. p. h.) have been equipped with electro-pneumatic brakes. Figure 1 indicates the essential elements of the present electro-pneumatic brake system. A pneumatically operated master controller is equipped with contacts which supply energy by means of train line wires to application and release magnet valves, one pair being on each vehicle. It will be noted that all application magnets are in parallel and all release magnets are in parallel, a common return being used for both sets of magnets. When an electro-pneumatic brake application is made, movement of the brake valve handle introduces air under pressure to the chamber on the left side of the master controller, Fig. 1, the pressure being proportional to the angular movement of the brake valve handle. The diaphragm of this chamber moves the lever controlling the contacts to the right, closing both contacts, and thus energizing both the release and application magnets throughout the train. Energizing the release magnets results in closing off the brake cylinders from atmosphere. Energizing the application magnets causes air under pressure to be admitted to the brake cylinders. At the same time, air at corresponding pressure is admitted from every vehicle to a pipe called the straight air pipe. This pipe is connected to the right hand chamber of the master controller. When the pressure in the straight air pipe and the chamber becomes equal to the pressure in the left hand chamber, the lever moves to the left, but only a sufficient amount to open the contact which controls the application magnets. This halts the build-up of brake cylinder pressure at the value demanded by the position of the brake valve handle. The magnet valves control brake cylinder pressure indirectly by means of a relay valve as shown in Fig. 1.

* Abstract of a paper presented at the Winter Meeting of the American Institute of Electrical Engineers held in Pittsburgh, Pa., January 26-30, 1948.
† Westinghouse Air Brake Company.

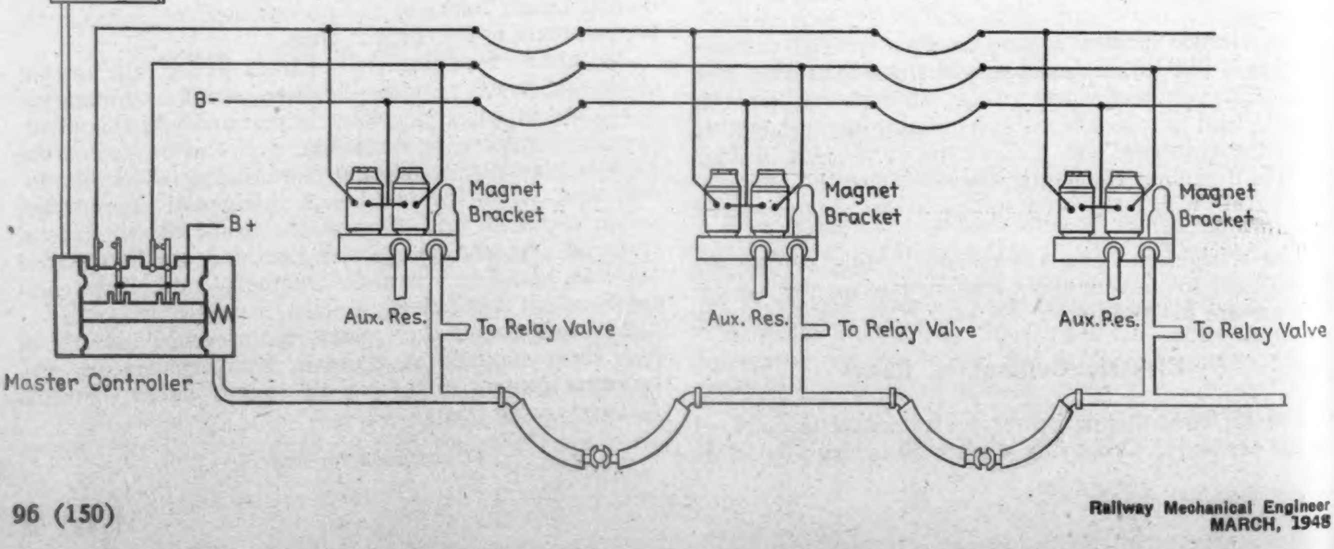


Fig. 1—Essential elements of electro-pneumatic brake system

Circuit Condition Indicator

It is desirable to have some means for indicating to the engineman any change which may take place in the condition of the circuits controlling the magnet valves throughout the train. The usual automatic air brake is always available and may be made operative by moving a lever on the brake valve. If sufficient time is not available to shift this change over lever, an emergency brake is available simply by moving the brake valve handle to its extreme applied position. Since the usual form of brake application requires only a service application, practical operating experience indicates the desirability of informing the engineman of any change in the condition of the electro-pneumatic brake circuits in order that in advance of a brake application, he may change to the automatic air brake and thus avoid the use of the emergency brake.

In considering a means for thus indicating the condition of the electro-pneumatic brake circuits, the following tentative requirements were made as presenting an ideal solution:

1. All equipment for checking should be on the locomotive.
2. Because of the large number of passenger cars now in service with the electro-pneumatic brake, no change in car wiring should be required.
3. The equipment must be designed to operate satisfactorily with trains varying in length from 1 to 24 vehicles.
4. The equipment must operate satisfactorily over a wide range of voltage, the limits being from 58 to 80 volts.
5. The equipment must be sufficiently rugged to operate satisfactorily on a locomotive, long life and a minimum of maintenance being essential.
6. No power supply other than that used on present locomotives should be required.
7. The equipment must indicate continuously in advance of a brake application, the condition of the electro-pneumatic brake system.

Indicating Light Panel

8. The indication means must be safe in that any failure of the equipment used for checking should provide the same indication as a failure of the electro-pneumatic brake system.
9. The checking current flowing through the magnet valves must be sufficiently low to insure against false operation.

With these requirements in mind, a system was devised which fulfills them. After making tests with numerous methods, it was finally decided that the use of the Wheatstone bridge was the solution. This old standby presents a ready means for accurately measuring the resistance of the magnet valves and the train line wires which control them and so could be used to indi-

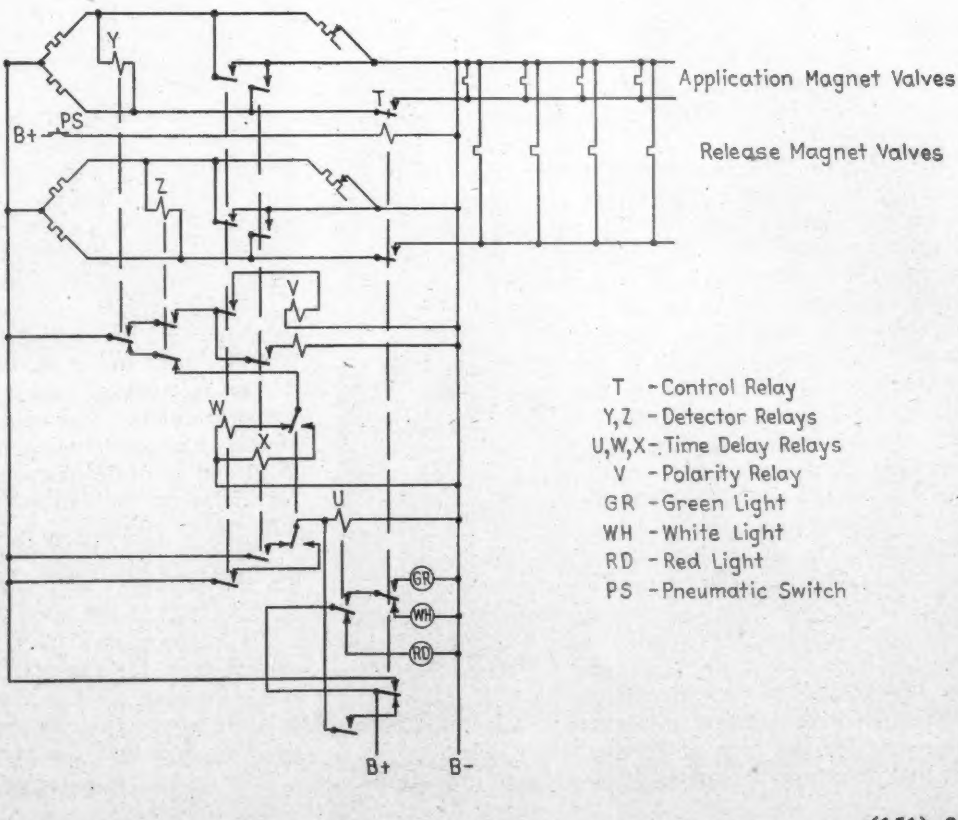


Fig. 2—Schematic diagram of circuit checking equipment

cate any change in resistance resulting from open circuits or short circuits. The disadvantage of using the Wheatstone bridge lies in the fact that a null indication represents a balanced condition. Therefore, a fault such as an open lead to the galvanometer in the Wheatstone bridge would indicate a balanced condition, and a fault in the brake system would not be detected.

One unique feature of the system finally adopted lies in the means for converting the Wheatstone bridge into a device which checks its own operation, as well as indicating any change in the condition of the circuits, whose resistances are being measured. Figure 2 shows schematically the circuits involved in the system and all devices are shown in the de-energized position, it being assumed that the battery supply is open.

Two bridges are used, one for checking the application wire circuits, and the other for checking the release wire circuits. The galvanometer usually associated with the Wheatstone bridge is replaced by a relay. This relay does not have to be a delicate instrument. In addition to detector relays *Y* and *Z*, three additional relays are used for controlling the bridges. Relays *W* and *X* are used to alternately short circuit one of two arms of each bridge. The third relay *V* is of the polarized type in that the position of its contacts is controlled by the direction of current flow through the coils. The contacts of this relay control the *W* and *X* relays to select which one is operated. The sixth relay in the system, relay *T*, is used to disconnect the circuit checking equipment from the application and release wires during a brake application and to indicate that the brakes are applied. The seventh relay *U* controls the light indication or other means to warn the engineman of faulty circuits.

Operating Sequences

The sequence of operations is as follows: One of the time delay relays, *W* or *X*, is first energized, shortcircuiting one arm of each bridge, and thus providing a large degree of unbalance to insure energizing detector relays *Y* and *Z*. The time delay relay then becomes de-energized, and the detector relays can release, provided there is no unbalance of the bridges sufficient to hold either relay energized. This completes one-half of the operating cycle. The polarity relay *V* is controlled by the action of the detector and time delay relays, and its contacts select which of the two time delay relays is to be energized.

If during the first half cycle the *W* relay is energized, thus placing a short circuit across the upper right hand arm of each bridge, then during the second half cycle, the *X* relay becomes energized, placing a short-circuit across the lower right hand arm of each bridge. It can be followed readily that if at any time a change in resistance takes place, whether it be a decrease or an increase, the *Y* or *Z* relays, or both, will be held energized when the short circuit is removed from the arms of the bridge, provided the change in resistance is such that the direction of current flow through the detector relays is not changed. This may occur during either the first or the last half of the complete cycle depending on the direction of unbalance.

It can also be seen that the amount of unbalance caused by the change in resistance need be great enough only to hold the detector relay energized. The detector relays *Y* and *Z*, as explained previously, may be rugged devices, and they are particularly designed to have a low drop out with respect to the pick up current.

Sensitivity to change in resistance can be made as desired. For the type of service being described, it is felt that detection of changes of 10 per cent are adequate, and that higher degrees of sensitivity would result in unnecessarily switching from the electro-pneumatic brake to the automatic brake with the consequent loss of the advantages of the former system. Therefore, the components of the circuit checking equipment have been designed to indicate a change in resistance of 10 per cent.

As relays *W* and *X* are alternately energized, relay *U* receives pulses of current to hold it energized, it being a time delay device so as to bridge the time between pulses. If, for any reason, these pulses cease, relay *U* will become de-energized and the green indication normally seen will be changed to red.

If a brake application is made the white light will become energized, provided the electro-pneumatic brake circuits, as indicated by the checking circuit equipment, had previously been intact. If a brake application were made with the red indication showing, the red light would continue to be energized.

Calibrated dials are used with the adjustable rheostats which form the upper right hand arm of each bridge and serve to indicate the number of vehicles in the train. Since most of the faults occur in the jumper connections between cars, these calibrated dials serve a further purpose in that they are of considerable aid in locating the source of trouble.

When initially taking control of the train, the engineman makes an electro-pneumatic brake application, and the train is inspected to insure that brakes apply properly throughout. This is an indication that the electro-pneumatic brake wiring is intact and functioning as intended. The number of vehicles in the train must be known to the engineman. If the train consisted of three locomotive units and twelve cars, a total of fifteen vehicles would be used in setting the rheostats. The dials of the rheostat knobs are calibrated from one to twenty-four vehicles. The engineman, after determining that the electro-pneumatic brake is functioning properly, and knowing the number of vehicles in the train, can then proceed to place the circuit checking equipment in operation.

The "on-off" switch to the left of the lights must be moved to the "on" position, and both rheostats should be turned so that the proper number of vehicles on the dial is opposite the indicator for each rheostat. With both rheostat dials so set, the three-position toggle switch to the right of the lights is moved, and held to the "up" position. This prevents the pulsing action of the relays and, at the same time, inserts a milliammeter in series with the corresponding detector relay. The power switch and three-position toggle switch are omitted from Fig. 2 in order to simplify the circuits. The rheostats should then be readjusted until each milliammeter reads zero. This insures that both bridges are balanced. The three-position switch should then be pulled to the "down" position until the green light is energized, after which it may be released, and it will automatically assume the center position. The calibration of the rheostat dials is merely an approximation, and the milliammeters are used to insure accurate balancing of the two bridge systems. Nevertheless, the calibration on the dials will serve to indicate, to a rather close extent, the number of vehicles in the train, and if there is any large variation between the dial settings and the actual number of vehicles in the train, a fault in the train wire system is indicated.

To locate such a fault, let us assume that in the 15 vehicle train the rheostat dial must be set to 12 to obtain a balance for the application wire. This indicates a faulty connection between the twelfth and thirteenth vehicles, and that the poor connection must be in the

(*Continued on page 154*)

Field Coil Machine Aids Repairs

Rock Island develops shop machine which eliminates damage when traction-motor or generator field coils are removed or replaced and reduces time required for both operations

Traction-motor and generator fields normally require little attention, but they do work loose, are subject to damage, and it is the opinion of some operators that they should be overhauled at regular intervals. On the Chicago, Rock Island & Pacific, traction-motor fields are taken out for reconditioning about every fourth armature cleaning period, or every 800,000 miles. Those on switching locomotives are overhauled every eight years.

Since the amount of this kind of work is small, railroad shop operators are not inclined to provide facilities for it. Pole pieces are frequently removed from the coils with a hammer, with the result that the work takes an unnecessary amount of time and removal frequently results in damage to the coils.

Equipment installed at the Silvis, Ill., shops of the Rock Island saves labor and insures high quality work. When the coils with their pole pieces are removed from the motor frame, they are replaced with reconditioned coils. The coils to be reconditioned are placed on a wooden rack and laid on a bench-high roller type conveyor. They are first rolled along the conveyor to the position shown in Fig. 1. The two hinged clamps which engage opposite ends of the coil are raised by the right-hand treadle against the counterweight shown under the bench at the right. They may be raised high enough to accommodate any coil having a thickness up to 10 in. When the treadle is released, the clamps are held in snug to the coil so that the hook or dog at the end of the clamps engage the upper surfaces of the coil when the clamp is brought down by the counterweight.

Fig. 1—Pole piece being removed from field coil

There is a 12-ton hydraulic cylinder on the cross member from which the clamps are hinged. The other two foot-treadles operate pumps, respectively, for high-speed and low-speed, high-pressure operation of the piston in the cylinder. The high-speed treadle is used to bring the piston up against the pole piece and the low-speed to push the pole piece out while the coil is held by the clamps. Since both the coil and pole piece are held in line during the operation, the pole piece is removed without damage to the coil.

The second operation is shown in Fig. 2. Here, the coil without the pole piece has been moved on its wooden frame to a growler. The growler consists of a primary winding on a U-shaped core. The U is in a horizontal position, and the upper leg is hinged to admit the coil, after which it is lowered to the position shown and a straight laminated section of core placed in the center of the coil to close the magnetic circuit; to make the U an O, or more accurately a rectangle.

The coil winding is left open and voltage is applied to the transformer primary. If the coil is good, the current in the transformer primary is too small to show on the ammeter in the circuit. If there is a shorted

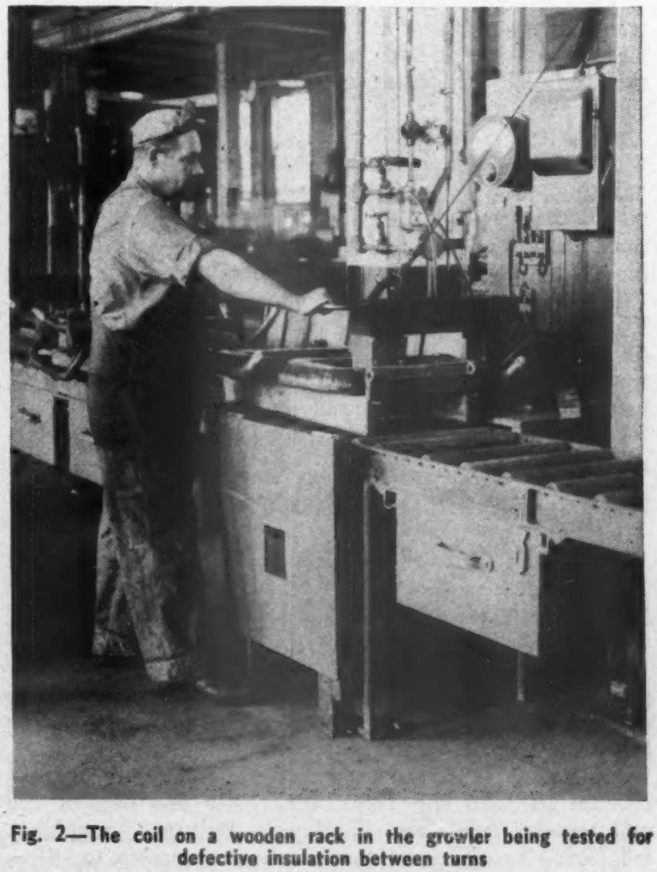


Fig. 2—The coil on a wooden rack in the growler being tested for defective insulation between turns

Fig. 3—Third position on roller conveyor showing pole piece being pressed into a reconditioned field coil

turn, the ammeter will show a reading.

To locate the short, a knife switch is used to short out the meter and other knife switches used to change transformer taps to increase the magnetic flux. Smoke will show the location of the short. This is usually close to an end turn, and can be repaired without rewinding the coil.

The wooden frames which carry the coils have strap-iron-wearing surfaces to protect them from the rollers. Each strap has an air gap at each side so it will not present a closed magnetic circuit when it is with the coil in the growler.

After the coils are given the growler test, they are vacuum impregnated and baked. Any old type coils having cotton outside wrappings are stripped and new outside asbestos tape applied. The tape is put on to a thickness which makes the opening in the coil about 1/16 in. less than the diameter of the pole piece.

Before the pole piece is replaced, the press shown in Fig. 3 is used to push a tapered wedge having a maximum diameter equal to the pole piece, through the coil. After this is done, the same press is used to push the pole piece into position. Pole piece and coil are then ready for application to any motor or generator of their type.

A. C. Air Conditioning

(*Continued from page 149*)

Characteristics of A.C. Air Conditioning Systems

Alternating current air conditioning equipments are powered by engine-driven generators carried on each car, or by turbine or engine generators located at the head end of the train. Alternating-current generators, with stationary armatures, and relatively low-power excitation through slip rings, inherently are free of the maintenance needs and liability to failure of machines employing brushes and commutators operating in dirty, wet atmospheres. These a.c. generators replace the following power supply components carried on each car employing the d.c. axle generator battery system: generator drive; generator; generator speed switch; generator reversing switch; generator voltage regulator; large power batteries. Failure or defective operation of any one of these components results in low battery voltage and failure of the air-cooling equipment.

The various compressors and fans in an a.c. system are driven by compact light-weight squirrel-cage motors, free of commutators and brushes found on d.c. motors. Thus, these d.c. maintenance items and sources of possible failure are eliminated entirely by the a.c. equipment. Use of hermetically sealed refrigerant compressor motors eliminates shaft seals, couplings, pulleys, and belts, other maintenance items associated with d.c. systems.

Adding up all the maintenance items, and sources of possible failure eleminated by a.c. air conditioning equipments, it is reasonable to expect that equipment failures as well as maintenance requirements can be held at a minimum in a.c. systems.

Reduction in battery size is another feature of the a.c. system. Battery size on d.c. systems increased to 57 cells weighing 9,500 lb. on one car order recently placed. On an a.c. car, battery size is reduced to 16 cells weighing 700 lb., serving only for emergency car lighting, and to crank engines on self-powered cars. Service requirements of the smaller battery with its light duty cycle are nominal as compared to the large battery with its severe duty cycle.

Power cable sizes on the 3-phase, 220-volt car are reduced to number 10 stranded wire. This cable is easy to install and is carried in small diameter conduit. The weight of small cable and conduit on one coach equipped with a.c. air conditioning equipment totalled only 677 lb., as compared to 2,502 lb. on a car equipped with conventional d.c. apparatus.

Finally, the a.c. equipped cars impose no parasitic axle generator drag on the locomotive. At an axle generator output of 20.0 kw., and allowing for generator and generator drive efficiency, each car in a train consumes 33 locomotive rail horsepower, which otherwise would be available for traction. On long trains, this parasitic drag may call for increased motive power, if scheduled speeds are to be maintained.

Checker For High-Speed Brakes

(*Continued from page 152*)

application wire. If both rheostats register 12 vehicles instead of 15, the fault might be in both the application and release wire, in the common return wire, or in all three. This means a fault location is applicable only if the fault is an open circuit existing in the plug connectors or jumper wires between cars. Experience has proven that most faults in the electro-pneumatic brake system are of this nature and consequently this method of fault location may be of considerable practical value from the standpoint of maintenance.

No attempt has been made to fully cover the circuit checking equipment in detail. A number of refinements vital to this particular application would be of little general interest. However, it is believed that the preceding information is sufficiently clear to give a general understanding of a new method for indicating change from a balanced condition. It can be used with any type of bridge circuit. The method is one which checks its own integrity, and which lends itself to applications demanding rugged apparatus, long life, and a minimum of maintenance.

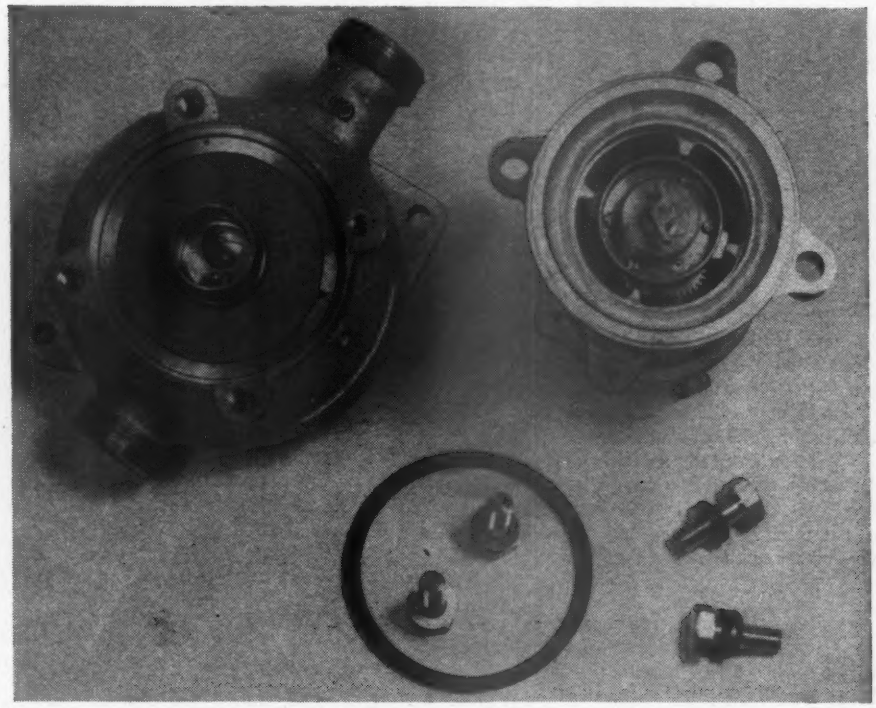
NEW DEVICES

Fuel Oil Meter for Diesel Locomotive Use

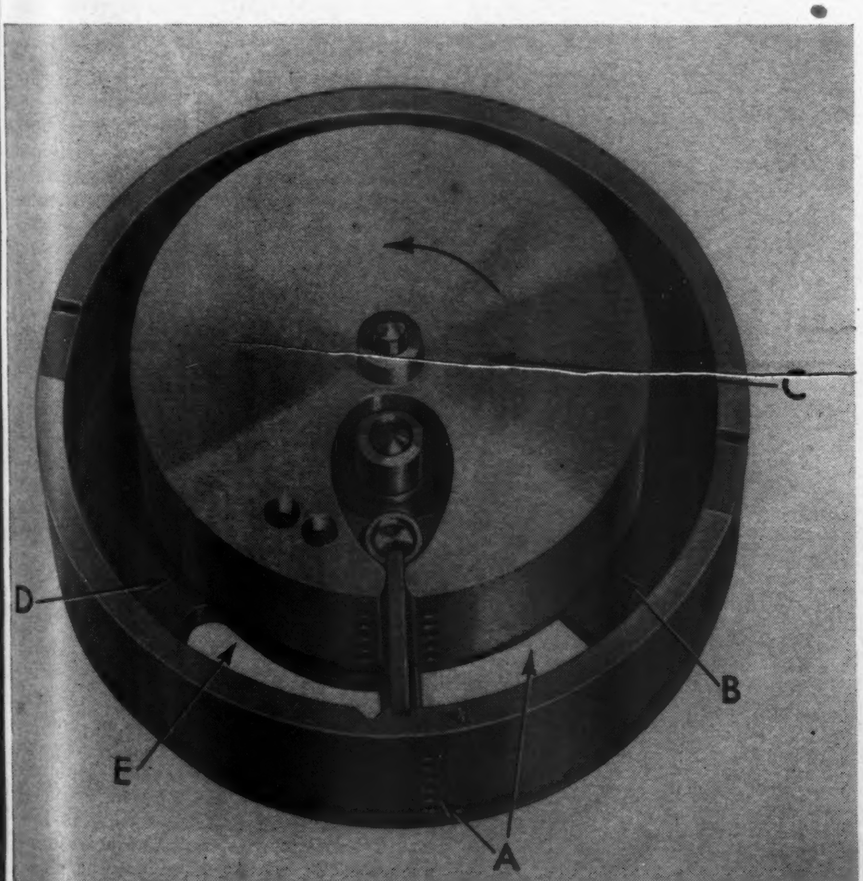
Neptune Red Seal fuel-oil meters for measuring the fuel consumption of locomotive Diesel engines are low-flow meters with a rate of flow per hour that varies from a minimum of 10 gal. to a maximum of 150 gal. The meters have a total register capacity of 999,999 gal., and are suitable for operation under a maximum working temperature of 140 deg. F., and a maximum working pressure of 125 lb. per sq. in.

The meter is a positive-displacement, oscillating-piston design with only one moving part in the measuring chamber—the piston. A continuous non-pulsating movement is said to result from the counter-clock-wise rotation of the circular piston which is guided in its motion by the spindle against the roller that holds the piston in contact with the walls of the chamber. A similar cycle occurs in the inner chamber formed by the piston and the inner ring. The circular motion of the spindle is transmitted through a gear train and stuffing box spindle to the register. Change gears, by means of which calibration is effected, are incorporated in the drive.

The casings have male-threaded studs for 1-in. ground-joint couplings. Couplings with straight tubes are furnished with the meter, but tubes bent 90 deg. are available. Special casings with a vertical inlet are also available. The piston is aluminum, and the lower and upper main casings, gears and measuring chambers are composition bronze. All gears are machine cut.



The upper main casing, containing the gear train of the Neptune meter, removed to show the top of the measuring chamber



In the measuring-chamber operation, liquid enters port A, passes into space B, and moves piston C in the direction shown, while the liquid in space B passes out through port E

Neptune Red Seal meters, either of the low-flow type for locomotive installation or the larger-capacity meters for fueling Diesel locomotives, are manufactured by the Neptune Meter Company, 50 West Fiftieth Street, New York 20.

Electric Tachometer

A hand-held electric tachometer which weighs only 3 lb. has been announced by the Special Products Division of the General Electric Company. The instrument is designed to give accurate and direct readings of linear speeds from 10 to 10,000 ft. per min., and of rotational speeds from 100 to 10,000 r.p.m. Using accessories, rotational speeds from 10 to 100,000 r.p.m. may be measured.

Typical applications include measuring rotational speeds of motors, generators, turbines, and engines, measuring cutting speeds in feet per minute on lathes and milling machines, and measuring linear speeds of planer beds, shapers, band saws, and conveyor belts.

The Tachometer consists of two units—the head, which is placed in contact with the moving object, and the indicating unit to which the head is attached by a flexible electric cable. Speed ranges can be changed

The tachometer being used to measure the speed of a motor

while the spindle is rotating because there is no gear transmission to shift for various speed ranges. Accurate speed indications are assured by a low driving torque of only ¼ ounce-inch. The instrument cannot be damaged by overspeeding.

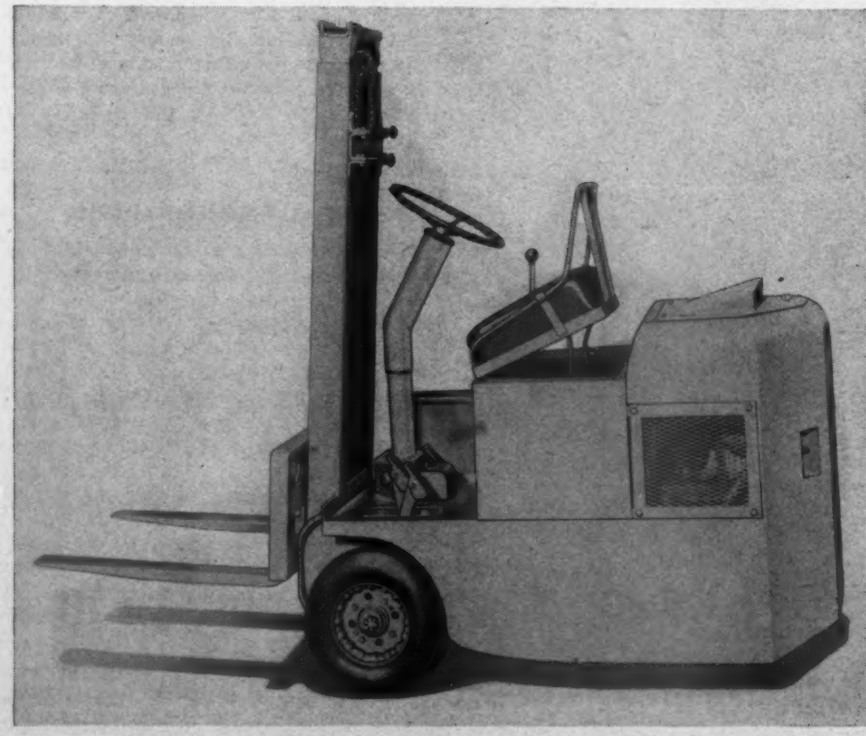
Vibration from the rotating machine does not affect the reading or make the instrument difficult to read. The instrument can measure both clockwise and counter-clockwise rotation. It is furnished in a carrying case.

One-Ton Fork Truck

The latest addition to the line of Chore Boy material-handling equipment built by the Buda Company, Harvey, Ill., is a fork truck with a capacity of 2,000 lb. The truck, known as the Thifty Lift, has an outside turning radius of 58 in. and will turn in intersecting aisles of 57 in. width. The overall width of the truck is 32 in. and the overall length, without the forks, 63⅜ in.

The maximum speed of the truck is 10 m.p.h. with four speeds forward and four speeds reverse. Motion from forward to reverse is changed by the clutch pedals. Stopping and holding the truck is effected by a standard pedal-type foot brake and, as an added safety feature, by an automatic brake which is applied whenever the operator leaves his seat.

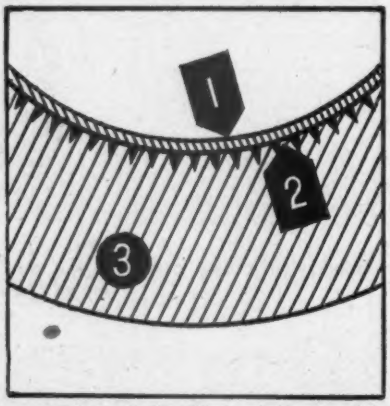
The tilting and lifting mechanism is fully hydraulic and runs on a power take-off from the main power unit, a two-cylinder air-cooled gasoline engine. Tilting angles are 10 deg. forward and 5 deg. backward. Lift extensions are available in either 7 ft. or 9 ft. lengths.



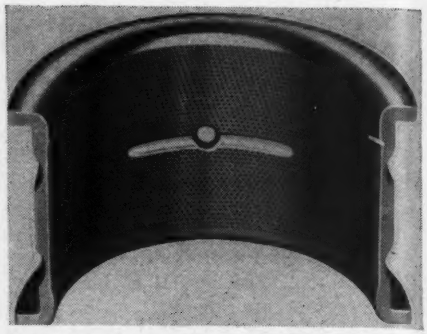
The Buda Chore Boy one-ton fork truck

Gridded Bearings

To combine such advantages of babbitt as conformability, embedability, and seizure resistance with the greater structural and fatigue strength of centrifugally cast lead-tin-bronze, a mechanical method of gridding that makes gridded bearings practical



Cross-section of the National Bearing Metal gridded bearings, showing 1 a .002 in. lead-tin alloy run-in surface, 2 the grid, and 3 the centrifugally-cast lead-bronze shell



N-B-M gridded bearings can be furnished either as half bushings or as full cylindrical bearings

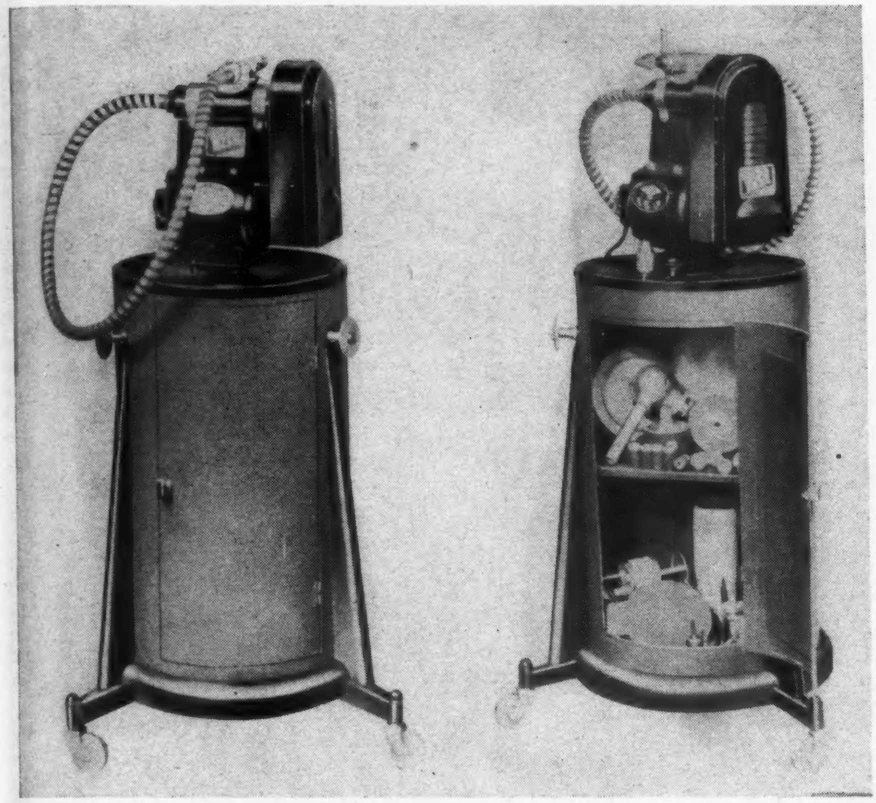
for mass production has been developed by the National Bearing Division, American Brake Shoe Company, St. Louis 10, Mo. The bearing consists of a .002-in. lead-tin alloy run-in surface, a grid filled with N-B-M silver babbitt, and a centrifugally cast lead-bronze shell. The run-in surface of the lead-tin is electroplated in the bore and is used to increase the seizure resistance and corrosion resistance of the gridded bearings.

These bearings were designed to provide the abiltity to conform to distortion under firing loads and working tolerances in a strong bronze as well as the ability to embed or absorb dirt or grit without harm to the bearing or the shaft. Objections to the use of bronze with a shaft that is not hardened are said to be overcome by the self-healing characteristic of the gridded bearing. This characteristic permits some of the babbitt to melt out of the grid and form a running surface that prevents seizure, thus providing a safety factor that prevents the damage to the shaft which would occur were an ordinary bearing to seize and fail.

Present applications of gridded bearings include main and connecting rods of Diesel engines and other heavy-duty service. The bearings can operate under loads exceeding 3,500 lb. per sq. in. with a shaft as low as 160 Brinell hardness. The minimum depth of the grid is .008 in., and the minimum area of babbitt is 40 per cent. The required balance between conformability and imbedability for individual applications is obtained by controlling the proportion of the land (the parent bronze) and the babbitt-filled grid. N-B-M gridded bearings are customarily made as half bushings but can be furnished as full cylindrical bearings if desired.

Portable Repair Facility

A flexible-shaft machine mounted on a transportable cabinet and containing 25 accessory tools plus two dozen supplies that enable a repairman to perform his job on nearly any location is produced by Wyzenbeek & Staff, Inc., 838 West Hubbard street, Chicago 22. Termed the Handy-Matic, this portable repair facility is furnished complete with tools and accessories for sawing or sanding metal or wood, drilling, wire-brushing, grinding, buffing, filing, disc sanding, carving, paint or varnish removal and waxing.



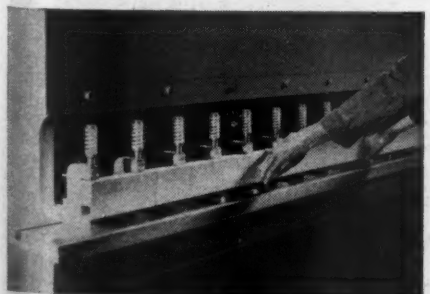
Portable motorized repair shop equipped with flexible-shaft machine and accessories for on-the-spot repairs

The Handy-Matic has a cabinet 32 in. high which is mounted on three caster legs and is equipped with shelves so that the accessories may be stored easily and located quickly. Power is supplied by a 60-cycle, ⅛-hp. motor, 110 or 220 volts. A V-belt drive supplies three speeds—1,400, 2,400 and 4,500 r p.m. The flexible shaft through which the power is transmitted is 5 ft. long and has a non-metallic innerliner.

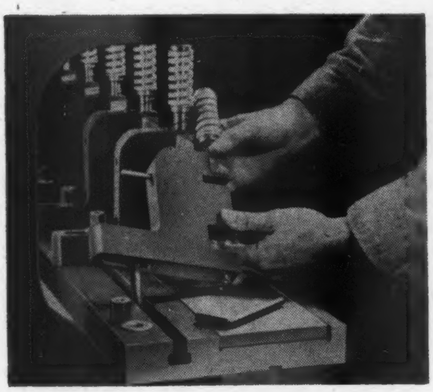
Punch Press

The Wales Type EJ hole-punching unit has been designed with a center projection to carry the die to make it possible to punch a series of holes simultaneously in angles, channels and extruded shapes. The units are independent and self-contained; nothing is attached to the press ram, which functions only to depress the punches.

All functioning parts, punch, guide, stripping spring and die are built in the holder which automatically aligns the punch and



A straight-line setup on the Wales-Strippit punching unit with the work in position on top of the dies and ready to be punched with the down stroke of the ram



Setting up a type-EJ punching machine by placing the punching units over bolts in the T-slot and by putting the pilot pins into holes in the strip template—The units are then locked to T-slot rails with nut, bolt and washer sets

die. In action, the full-floating punch located in the top of the holder is depressed by the press ram and is guided through the work and into the die by a long guide. On the down stroke of the ram, the stripping spring is compressed. On the upstroke it expands to strip the punch from the work.

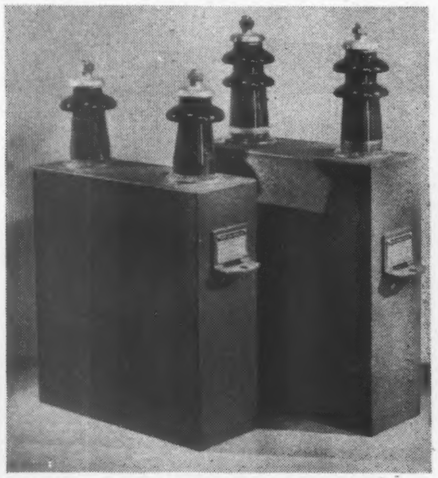
For strip-template-method setups, hole locations are drilled and reamed in the strip template for the pilot pin. These templates are combined pattern-and-base plates which permit templates not in active service to be stored for future use. The group of type EJ units which has been removed may be kept in continuous operation on other strip templates, thus eliminating dead storage of units. The templates are interchangeable in the press brake rail so that the rail may remain in the press brake while using type EJ hole-punching units.

The Wales type EJ punching unit is a product of the Wales-Strippit Corporation, North Tonawanda, N. Y.

Distribution Capacitor

A 25-kvar. individual distribution capacitor with lower weight per kvar. than existing 15-kvar. units is announced by the Westinghouse Electric Corporation. Similar in design, dimensions and appearance to present Westinghouse 15-kvar. units, the 25-kvar. capacitors are 66⅔ per cent greater in capacity with increase in weight and volume of only 50 per cent. Units mount in standard one-, two, or four-unit racks of the same size as previously furnished for the 15-kvar. capacitors.

The dielectric is Inerteen; porcelain terminals are solder sealed for tight, weatherproof bushing joints. The steel case is



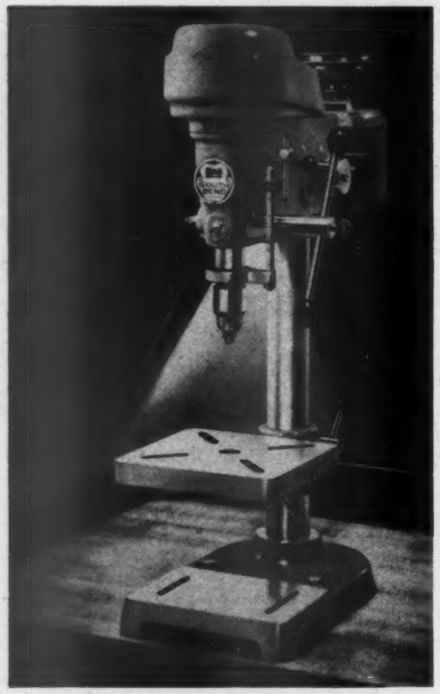
Comparative sizes of the new 25-kvar. capacitor and the 15-kvar. capacitor

all welded with a weatherproof zinc spray finish for long life. The 25-kvar. capacitors are available for all the usual distribution voltages from 2,400 volts delta or 4,160 Y to 7,960 volts delta or 13,800 Y.

Small Drill Press

A drill press having a capacity to drill ½-in. holes in iron or steel at the center of a 14-in. circle is manufactured in both bench and floor models by the South Bend Lathe Works, 403 East Madison street, South Bend 22, Ind. The press has a built-in light with an independent switch to give shielded illumination over the work area without installing a separate lighting fixture. A quick-acting belt-tension release lever simplifies changing the spindle speeds. It returns the vertically mounted motor to its original position after each change, thereby maintaining the same belt tension for each of the four cone-pulley steps.

The spindle has a maximum travel of 4 in. and speeds of 707, 1,305, 2,345 and 4,322 r.p.m. The spindle is of a free-floating design to prevent misalignment, side thrust and whip. The depth gauge is graduated in sixteenths of an inch and has adjustable collars to control both the depth



Bench model of the South Bend drill press

of the feed and the length of the return stroke. Two precision ball bearings carry the drive-unit load and two additional ball bearings carry the spindle, which is spline driven. All ball bearings are prelubricated and sealed, and therefore require no oiling. The spindle-quill bearing has an adjustment to compensate for quill wear.

A full tilt-type table, with a 10-in. by 10-in. ground top surface, has slots for clamping fixtures or work. A double-plug binder locks the table in any position on the 2¾-in. diameter column. The bench-model drill press has a 10⅞-in. maximum chuck-to-table distance, a 10⅞-in. table travel, a 17-in. maximum chuch-to-base distance, a 10¾-in. by 17¾-in. slotted base with a ground top surface, and an over-all height of 35½ in. The floor madel has a 40⅛-in. maximum chuck-to-table distance, a 40⅛-in. table travel, a 46½-in. maximum chuck-to-base distance, a 15-in. by 21-in. slotted base with a ground top surface, and is 65½ in. in over-all height.

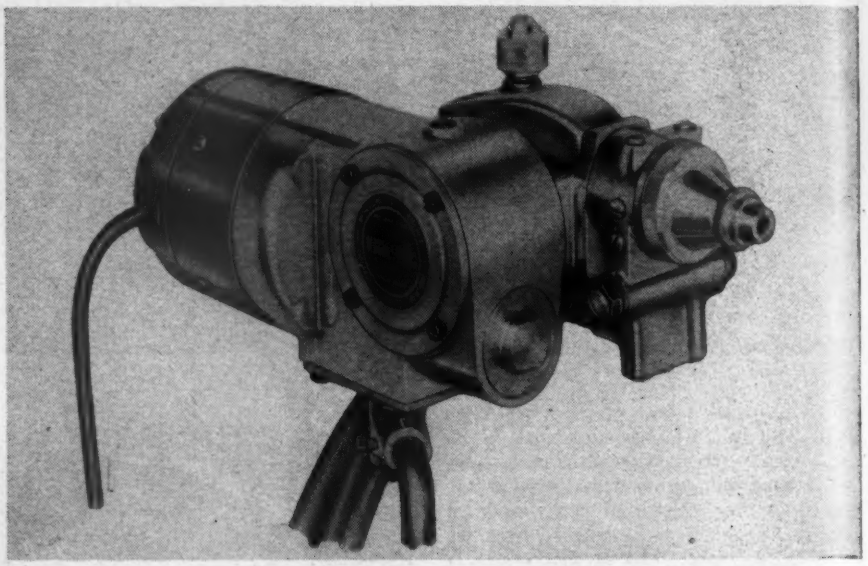
Either model of the drill press is supplied with or without the ⅛-hp., 1,725-r.p.m. vertical-mounting type of motor required. An on-off switch, motor-line connection cord, V-belt, motor pulley, and 0- to ½-in. capacity chucks are standard.

Electric-Driven Metallizing Gun

To reduce air requirements materially and to eliminate turbine speed adjustment, the Mogulectric metal spray gun is powered by a 1/20-hp. constant-speed induction motor. The gun uses different combinations of gearing to obtain the various speeds required for spraying at top efficiency any of the metals used in the metallizing industry. The constant-speed motor assures a uniform wire speed and eliminates damage to the nozzle due to incorrect turbine speed adjustment. The only adjustments required are those for gas and air.

At the front end of the motor is the gear reduction which runs in a bath of fluid grease and is enclosed in an aluminum housing. All shafts are mounted in oversize ball bearings. The gas head is a pressure-tight bronze casting which has a removable nozzle seat that can be replaced if the seat becomes damaged through careless handling. The wire nozzles are made of copper with a hardened-steel insert. There is no adjustment to the air cap, as this is held in fixed position. The valve lever operating the simultaneous-control taper valve is located in a convenient and accessible position.

To put the gun in operation it is only necessary to turn on the switch and light the gun. The drive component carrying the feed rolls and combustion unit can be swung around from a horizontal spraying position so the gun can spray vertically, up or down or at any angle if desired. The feed rolls can be removed for cleaning if necessary; no special tools are required.



The Mogulectric metal spray gun is powered by a constant speed induction motor—The only adjustments required are those for gas and air

The Mogulectric is available for use with 25-, 50- or 60-cycle a.c. from the Metallizing Company of America, 1330 West Congress street, Chicago 7.

Spray Gun

A spray gun said to handle all types of finishes is announced by the Binks Manufacturing Company, 3116-18 Carroll avenue, Chicago 12. Known as the Model 18, the controls are located at the back of the gun and the spray pattern is adjustable from round to flat with all intermediate patterns. The gun body is of drop-forged aluminum with black electrolytic coating for surface protection. The gun head and air nozzle are drop-forged bronze with heavy plating.

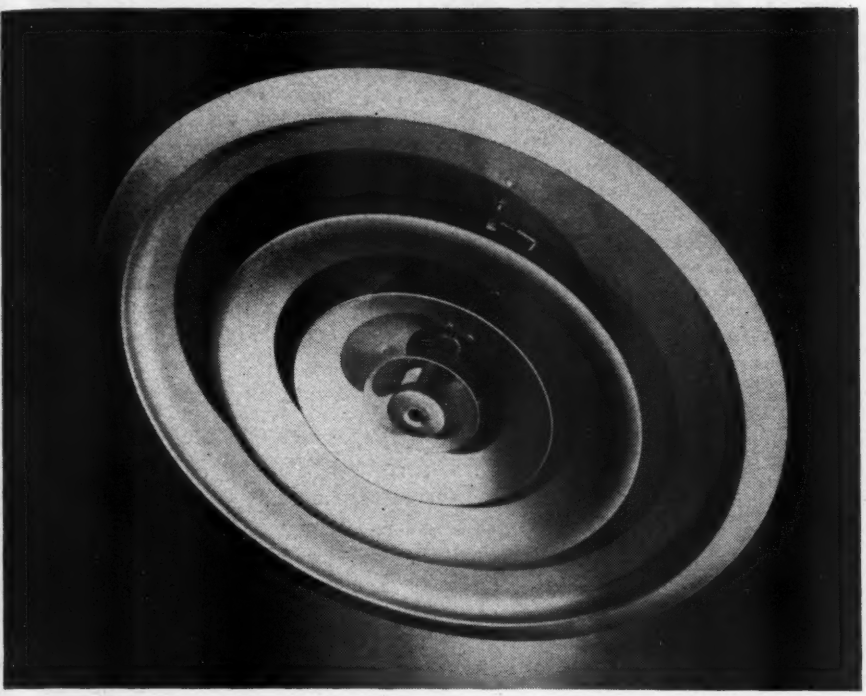
The nozzle of the spray gun is hardened steel, as is the needle valve, which is adjustable to compensate for wear. Its self-centering nozzle is designed on a tapered seat principle. A cartridge-type air valve is used. The two-finger trigger is protected from wear by a hardened plate on the back. All gun parts are made of wear- and corrosion-resistant materials; all connections are of standard pipe threads.

The Binks Model 18 spray gun

Adjustable Air Diffuser

The type C-1 Anemostat furnishes any desired air flow pattern by the turn of a knob through an adjustment mechanism which varies the vertical position of the third cone. This produces different air-flow patterns ranging from draftless diffusion to downward projection without affecting air resistance. The diffuser utilizes the aspiration principle of drawing room air into the device and mixing it with supply air. The proportion of air drawn into the outlet can be varied by the adjustment setting from 15 per cent to 35 per cent.

This adjustable feature of the type C-1 Anemostat permits it to be used for heating, ventilating, or cooling in any combination. The air-flow pattern may be modified to meet changing conditions of room occupancy or seasonal weather variations. It can be adjusted to neutralize the effect of local sources of heat gain or loss or air-distribution problems caused by beamed ceilings, nearby walls, or columns. It functions equally well mounted flush to the ceiling or on exposed duct work. Adjustment of the device can also be accomplished by remote automatic or manual control. Pneumatically operated control equipment may be used to adjust any number of Anemostats simultaneously.



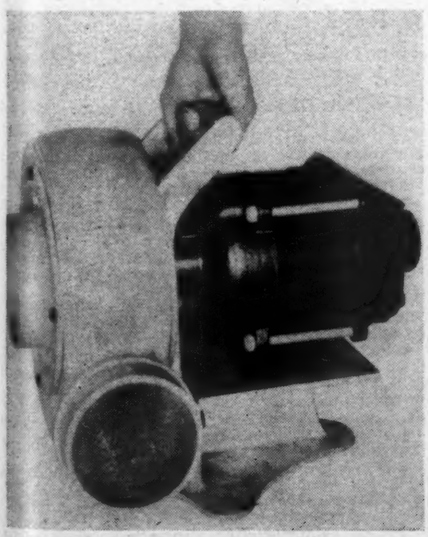
The adjustable type C-1 Anemostat

Installation is simplified and installation time said to be reduced two thirds over previous methods by a latch-like method of fastening the inner assembly to the outer cone. Since the inner-cone assembly is instantly removable, direct readings of the cubic foot per minute of air can be taken in the neck of the Anemostat. This reduces the time required to balance the system.

The diffuser is manufactured by the Anemostat Corporation of America, 10 East Thirty-Ninth street, New York 16.

Lightweight Portable Ventilator

Designed to improve worker efficiency by providing fresh air to workers in confined places, an aluminum portable safety ventilator has been developed by the United Electric Motor Company, 178 Centre street, New York. Known as the Saf-T-Air, this electric-motor-driven ventilator can be used either as a blower or an exhauster for eliminating hazardous gases, fumes, vapors, dust and foul air from drums, vats, tanks, boilers and other inaccessible places.



Portable aluminum ventilator manufactured by the United Electric Motor Company

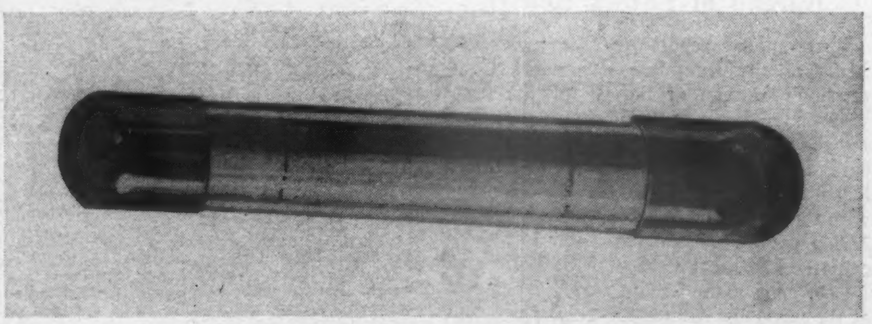
The Saf-T-Air, which can be passed through small openings, has a capacity of 425 cu. ft. of air per minute and a weight of 50 lb. The carrying handle is placed over the center of gravity of the unit for better balance when being carried or hung and to prevent the ventilator from tipping over. The size is sufficiently small to permit passage through small openings.

Temperature Indicator

A development in indicators which shows temperatures by color is manufactured by the Kolor Therm Indicator Corp., 434 Broadway, New York 13. Known as the Kolor-Therm, the device may be used on electrical appliances, single-phase motors, chemical apparatus, railway journal boxes, and other mechanical applications.

The Kolor-Therm is yellow at 100 deg. F. or less and turns gradually from orange to red as the temperature increases. By comparing with color standards, the approximate operating temperature or danger point can be seen, the latter being indicated by a full red. Upon cooling, Kolor-Therm again becomes yellow.

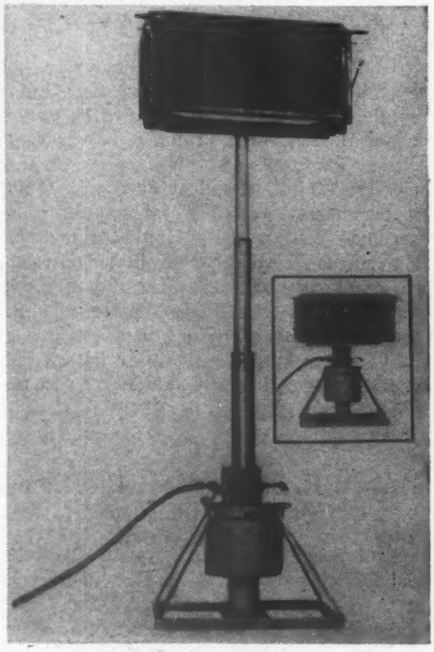
Kolor-Therm is made in two models, one suitable for a maximum temperature up to 190 deg. F. and the other up to 250 deg. F.



The Kolor-Therm indicates temperature in color

Hydro-Pneumatic Hoist

The Chadlift hydraulic hoist is designed to reduce the time, effort, damage and hazard involved in installing or removing such heavy items of equipment as air-conditioning coils and heavy blower fans. It is built in three sections for easy portability and can be moved through passageways and doors as narrow as 20 in. It can be quickly assembled or disassembled.



The Chadlift hydro-pneumatic hoist in raised position with insert showing the hoist in lowered position

The table of the hoist is only 30 in. from the floor level. Air pressure on the oil raises the ram to a total of 97½ in. above the floor. With a 600-lb. load on the table the hoist travelled 67½ in. in 40 sec.

The Chadlift hydro-pneumatic hoist is a product of Lifter, Hutchins & Steele, Inc., 7922 Beverly boulevard, Los Angeles 36, Calif.

NEWS

Mechanical Division Scholarship at Stevens Institute

The Mechanical Division, Association of American Railroads, because of the demand for mechanical engineers brought about by the interruption of training during the war years, is calling especial attention to its scholarship at the Stevens Institute of Technology. The scholarship, established in 1891, has a total value of $1,200 and is available in September to sons of members of the Mechanical Division. The student selected will be eligible to receive the benefits of other scholarships and load funds if the need arises in his upper class years.

Stevens Institute of Technology, a college of general engineering, offers but a single course leading to the degree of mechanical engineer. Training, however, includes instruction in the fundamentals of electrical, civil, chemical engineering, and management. Detailed information concerning qualifications for entrance at Stevens can be obtained from the Director of Admissions, Stevens Institute of Technology, Hoboken, N. J. Applications for the scholarship should be in the hands of A. C. Browning, secretary, Mechanical Division, Association of American Railroads, not later than March 31, 1948.

A. A. R. Mechanical Division To Meet in June

The next annual meeting of the Mechanical Division of the A. A. R. will be held at the Congress otel, Chicago, June 28, 29 and 30. This is a business session of the division and it is not planned to hold any exhibition of railway equipment and supplies.

Waugh Twin Cushion Draft Gears Approved for All Freight Cars

The Association of American Railroads has issued an official draft-gear certificate approving the unlimited application of Waughmat twin cushion draft gears for all freight cars accepted in interchange service.

Bureau of Safety Report

The annual report of Director S. N. Mills of the Interstate Commerce Commission's Bureau of Safety for the fiscal year ended June 30, 1947, shows that during the year under review, 1,061,699 freight cars, 24,767 passenger-train cars and 12,795 locomotives were inspected, as compared with the inspection of 1,203,408 freight cars, 27,840 passenger-train cars, and 14,580 locomotives in fiscal 1946. Of the 1947 total, 3.4 per cent of the freight cars, 3.7 per cent of the passenger-train cars and 5.3 per cent of the locomotives were found to be defective, as compared to the respective 1946 figures of 3.2 per cent, 4 per cent and 5.4 per cent.

Air brakes checked on 2,568 trains (consisting of 107,327 cars) prepared for departure from terminals were found operative on 107,182 cars, or 99.9 per cent. This percentage was attained, however, only after 1,773 cars having defective brakes had been set out, and repairs had been made to the brakes on 1,384 cars remaining in the trains. "These trains," the report observes, "had been prepared for departure, yet when afterward tested by our inspectors, it was necessary to set out or repair the brakes on an average of 1.2 cars per train." Similar tests on 1,450 trains arriving at terminals with 74,307 cars showed that the air brakes were operative on 97.9 per cent of the cars, and

Orders and Inquiries for New Equipment Placed Since the Closing of the February Issue

Locomotive Orders

Road	No. of locos.	Type of loco.	Builder
Canadian Pacific	20	1,000 hp. Diesel-elec. switch	Montreal Loco. Wks.
	14	1,000 hp. Diesel-elec. switch	Canadian Loco Co.
	5	Diesel-elec. pass.	Canadian Loco Co.
	5	Diesel-elec. frt.	Canadian Loco Co.
Erie	2[1]	6,000-hp. Diesel-elec. frt.	American Loco. Co.
	2[1]	6,000-hp. Diesel-elec. frt.	Electro-Motive
	4[1]	Diesel-elec. switch	Baldwin Loco. Wks.
	4[1]	Diesel-elec. switch	American Loco. Co.
	5[1]	Diesel-elec. switch	Electro-Motive
Nashville, Chattanooga & St. Louis	21[2]	1,500-hp. Diesel-elec. road units	Electro-Motive

Locomotive Inquiries

Road	No. of locos.	Type of loco.	Builder
Louisville & Nashville	22	2-8-4	

Freight-Car Orders

Road	No. of cars	Type of car	Builder
Canadian Pacific	1,000	50-ton box	National Steel Car
	200	Ballast	National Steel Car
	100	70-ton covered hopper	National Steel Car
	350	70-ton gondola	Eastern Car & Fdry.
	350	70-ton triple hopper	Eastern Car & Fdry.
	100	40-ton cabooses	Company shops
Clinchfield	1,000	50-ton hopper	American Car & Fdry.
Denver & Rio Grande Western	250[3]	70-ton hopper	Pullman-Standard
Illinois Central	1,000[4]	50-ton coal hopper	Pullman-Standard
	1,000[4]	50-ton hopper	General American
New York Central System	2,000[5]	55-ton box	Despatch Shops
	2,000[5]	55-ton hopper	Despatch Shops
	1,000[5]	70-ton gondola	Despatch Shops

Passenger-Car Orders

Canadian Pacific (see notes)

Freight-Car Inquiries

Road	No. of cars	Type of car	Builder
Chicago & North Western	1,000	50-ton box	
	650	70-ton triple hopper	
	650	Fixed-end gondola	
	50	70-ton drop end gondola	
Wheeling & Lake Erie	500	50-ton drop-end gondola	

Passenger-Car Orders

Road	No. of cars	Type of car	Builder
Atchison, Topeka & Santa Fe	27	All-room sleeping	Budd Co.
	29	Sleeping	American Car & Fdry.

[1] Delivery of this equipment is expected early next year. Two of the freight locomotives will be used between Jersey City, N. J., and Buffalo, N. Y., and two will be placed in service between Hornell, N. Y., and Marion, Ohio. Seven of the switching locomotives will be assigned to the Croxton, N. J., yard, three to Jersey City, one to Weehawken, N. J., and two to the Buffalo area.

[2] The locomotives, which will cost $3,287,000, are the first Diesel road units to be purchased by the N. C. & St. L. They will be delivered during 1948 for service between Bruceton, Tenn., and Atlanta, Ga., and can be interchanged in passenger and fast freight service.

[3] Delivery scheduled to begin in July.

[4] The coal hopper cars will cost approximately $4,000,000. The other 1,000 cars are to be delivered the latter part of this year.

[5] Half of each group of cars is intended for the New York Central and half for the Pittsburgh & Lake Erie. Deliveries of the hopper cars will be made from August through December of this year, the box cars are scheduled for delivery between December, 1948, and March, 1949, and the gondola cars will be delivered in the period of March-May, 1949.

Notes:

The *Canadian Pacific* has placed orders with the National Steel Car Company for 25 frames and trucks for first class coaches and 5 frames and trucks for double bedroom-roomette sleeping cars and with Canadian Car & Foundry for 10 mail-express and 15 baggage-express cars and 50 frames and trucks for first class coaches. All frames and trucks are being purchased for cars ordered built in the road's own shops.

The *Chicago, Rock Island & Pacific* has authorized expenditures totaling more than $33,000,000 for improvements and for the purchase of 57 Diesel-electric locomotives and 2,000 freight cars. The equipment to be purchased will include ten 1,500-hp. Diesel-electric locomotives for Dieselization of about half of the road's suburban service. The following Diesel locomotives will be purchased for delivery during 1948: ten 1,000-hp. switchers, ten 1,500-hp. road switchers and eight 4,500-hp. road freight locomotives, at a cost of $5,688,000; and ten 1,500-hp. engines for suburban service, which will cost $1,300,000. $9,000,000 will also be spent for the purchase of 1,500 box cars and 500 70-ton hoppers. Authorized for delivery in 1949 were five 1,000-hp. switchers and ten 4,500-hp. road freights, at a cost of $4,700,000. The road has or is about to receive four 4,000-hp. Diesel-electric passenger locomotives built by the Electro-Motive Division of General Motors Corporation. The Rock Island's major line, signal and relocation program will be continued, it was stated, and it is expected that approximately $13,000,000 will be spent for these improvements. Some $1,000,000 has been alloted to new or improved passenger and freight stations, shops and other building construction.

The *Nashville, Chattanooga & St. Louis* has approved an expenditure of $328,000 for three lightweight streamlined cars, which is the road's proportion of equipment for a new streamline train between Chicago and Florida to be operated on the "Dixie Route."

that an average of approximately one car per train was not controlled by power brakes.

"The annual reports of the past several years mentioned use by certain carriers of devices designed to make lock blocks of tight-lock couplers inoperative, to compensate for defects in the coupler which were productive of undesired separation of trains," the report continued. "Considerable progress has been made by the various carriers during the year in replacing those defective couplers with couplers of a modified design which are intended to avoid accidental separation."

According to the report, 685 reporting railroads and private car lines which collectively own 2,135,301 freight cars, have equipped a total of 1,488,859 such cars with power brakes of specifications complying with those set out in the commission's September 21, 1945, order which requires the installation of such brakes by January 1, 1949, on all cars used in freight service, except those equipped with passenger-car brakes. The breakdown of the figures shows that 72.9 per cent of the railroad-owned cars were equipped as of last June 30, but only 48.1 per cent of the cars owned by private car lines.

"Tests of geared hand brakes conducted by the Association of American Railroads during the fiscal year resulted in the certification of two additional horizontal-wheel brakes," the report continued. "Up to June 30, 1947, 12 vertical-wheel geared brakes and 6 horizontal-wheel geared brakes had been certified by that association. The operation of the load-compensating brake has been demonstrated in the laboratory of the manufacturer, and the Association of American Railroads has approved the application of the 'AB' load-compensating brake to 1,500 cars in interchange service for experimental road-service tests similar to the tests heretofore made of the experimental 'AB' brake cars."

"Must It Rust?"

THE American Hot Dip Galvanizers Association, Inc., 1611 First National Bank building, Pittsburg 22, Pa., has available through its secretary and treasurer, Stuart J. Swensson, a 16-mm motion picture sound film, "Must It Rust?", depicting the zinc coating by the Hot Dip Galvanizing process industry. The picture, which has a running time of 25 min., shows the steel base metal actually rusting as viewed through a microscope and the "cleaning" of the base metal by the pickling process. Also explained is the galvanizing of various products and metallurgical photographs of the construction of a zinc coating by Hot Dip Galvanizing.

Erie to Equip Three Divisions With Train Communication

THE Erie already has begun installation of a radio train communication system on its Kent, Mahoning, and Meadville Divisions, to provide complete coverage over more than 300 miles and main-line trackage between Marion, Ohio, and Salamanca, N. Y. Complete installation, with full operation, is expected by May first. Equipment used in the system is being delivered by the Farnsworth Television & Radio Corp., Fort Wayne, Ind.

All main-line Diesel passenger and Diesel freight locomotives operating over these three divisions of the Erie will be radio-equipped. This will include both cabs of seven three-unit passenger locomotives and nine four-unit freight locomotives, as well as 15 cabooses, a total of 47 mobile radio installations. In addition, 14 wayside offices will be equipped to provide complete radio coverage.

The installation will permit instantaneous and constant communication between the engineman in the cab and the train conductor in the caboose, as well as by both of them with wayside offices and crew members of other radio-equipped trains.

The system will utilize only very high frequency space radio-telephone circuits for fixed point-to-train and front-to-rear train communications. Plans also include the use of walkie-talkie radio sets for head-end and rear-end communications on both freight and passenger trains.

Equipment Depreciation Rates

EQUIPMENT depreciation rates for the Atchison, Topeka & Santa Fe are among those prescribed by the Interstate Commerce Commission in a recent series of sub-orders modifying previous sub-orders in the general proceeding, Depreciation Rates for Equipment of Steam Railroad Companies. The rates for the Santa Fe are prescribed in Sub-order No. 269-B, which is a modification of Sub-Order No. 269-A.

They are as follows: Steam locomotives, 2.7 per cent; Diesel-electric road locomotives, 4.9 per cent; Diesel-electric switchers, 3.88 per cent; refrigerator and ice cars, 4.7 per cent; other freight cars of wood-underframe construction, 3.6 per cent; other freight cars of steel and steel-underframe construction, 3 per cent; lightweight passenger-train cars, 3.89 per cent; other passenger-train cars, 3.26 per cent; floating equipment, 2.87 per cent; work equipment, 3.5 per cent; miscellaneous equipment, 12.6 per cent.

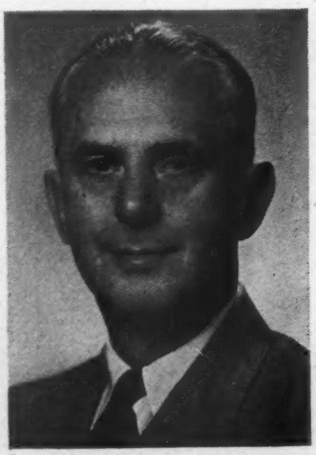
Supply Trade Notes

SIMMONS-BOARDMAN PUBLISHING CORPORATION.—*Samuel O. Dunn,* chairman of the Simmons-Boardman Publishing Corporation—publishers of the *Railway Mechanical Engineer*—has been elected, also president of the corporation. *James G. Lyne,* assistant to chairman, has been elected executive vice-president. Messrs. Dunn and Lyne will continue, as heretofore, to share jointly the editorship of *Railway Age. H. H. Melville,* district sales manager for the corporation's transportation periodicals at Cleveland, has been elected a vice-president, as has also *C. W. Merriken,* district sales manager at New York.

◆

INLAND STEEL COMPANY.—*John J. Davis, Jr.,* has been appointed manager of sales, Railroad division, of the Inland Steel Company, with headquarters at Chicago, succeeding *William J. Hammond,* who retired on January 1.

John J. Davis, Jr., was born on August 3, 1894, at White Pigeon, Mich., and received his higher education at Purdue University and the Armour Institute of Technology. He began his railroad career with the Elgin, Joliet & Eastern in 1913, serving successively as rodman, instrument man, assistant engineer and supervisor of track. He joined the Illinois Steel Company at Chicago in 1935 as sales engineer in the company's Railroad Materials and Commercial Forgings division, and in the latter part of the year he went with the Carnegie-Illinois Steel Corporation in a similar capacity. He subsequently served as assistant manager of sales, acting manager of sales and manager of sales of Carnegie-Illinois' Railroad Materials and Commercial Forgings Division. Mr. Davis resigned his post with Carnegie-Illinois to join Inland Steel on June 20, 1947, at which time it was announced that he would succeed to the position of manager of sales, Railroad division, on January 1, 1948.



John J. Davis, Jr.

◆

CLEVELAND TWIST DRILL COMPANY.—The Cleveland Twist Drill Co., as a gesture of good will to the metal-working industry, is dedicating to the public five of its patents covering tools embodying hard non-ferrous metal inserts such as may be formed of tungsten carbide. This dedication covers the following patents: Re. 19,182, Drill and Like Instrument and

Method of Making Same; 1,887,372, Cutting and Forming Tools; 1,887,373, Reamers and the Like; 1,887,374, Drill; 1,977,-845, Cutting and Forming Tools, Implements and the Like, and Method of Making Same.

◆

Reed Roller Bit Company.—The Reed Roller Bit Company of Houston, Texas, has entered the pneumatic tool industry. The Cleco Division of Reed Roller Bit has been organized as a separate division

W. J. Vossbrinck

for the manufacture and distribution of rotary and reciprocating pneumatic tools for general industry. *W. J. Vossbrinck* has been appointed sales manager. Mr. Vossbrinck is a graduate of Lafayette College (1934) in mechanical engineering and is a member of the American Society of Mechanical Engineers and the Society of Automotive Engineers. He comes to Reed after thirteen years' experience in the pneumatic tool and compressor industry.

◆

John W. Miller Company.—*David L. Chamberlin* has been appointed vice-president of the John W. Miller Company. Mr. Chamberlin was formerly with the New York Central for 22 years.

◆

Westinghouse Electric Corporation.—*F. D. Weatherholt*, formerly eastern resale manager of the Westinghouse Electric Corporation, has been appointed assistant industrial sales manager, with headquarters at East Pittsburgh, Pa. *George E. Richardson* has been appointed assistant to the manager of the feeder division.

◆

Pressed Steel Car Company. — The Pressed Steel Car Company has announced that its freight car sales offices in Pittsburgh, Pa. (the company's home office), New York and Chicago, shortly will be consolidated in Chicago.

◆

Nathan Manufacturing Company.—*Ward Grantham*, formerly assistant to the president of P. R. Mallory & Co., Indianapolis, Ind., has joined the Nathan Manufacturing Company as assistant to the president.

◆

Carnegie-Illinois Steel Corporation.—*John A. Schwer*, superintendent of production planning at Carnegie-Illinois' Gary Sheet & Tin Mill at Gary Ind., has been appointed assistant to general superintendent. Mr. Schwer is succeeded by *Joseph M. Greer*, formerly assistant to general manager of production planning of Carnegie-Illinois at Pittsburgh, Pa.

◆

Baldwin Locomotive Works.—*R. F. Doolittle* has been appointed vice-president, legal; *Frank B. Powers*, assistant vice-president, engineering; *R. B. Crean*, assistant vice-president, production; *R. N. Watt*, assistant vice-president, domestic sales, and *C. A. Campbell*, assistant vice-president, foreign sales, of the Baldwin Locomotive Works.

◆

Standard Stoker Company.—The Standard Stoker Company has removed its offices from 350 Madison avenue to 370 Lexington avenue, New York 17.

◆

General Controls Company.—*E. B. Maire*, formerly regional sales manager for the General Controls Company, has been appointed sales manager for its Boston, Mass., Philadelphia, Pa., Pittsburgh, Birmingham, Ala., New York, Detroit, Mich., Cleveland, Ohio, and Chicago branch offices.

◆

Dampney Company of America.—The Dampney Company of America, Hyde Park, Boston, Mass., has appointed *W. T. Quimby*, of Springfield, Mass., as special representative in the New York area for Apexior and Thur-ma-lox protective coatings. The *Paxton Company*, Norfolk, Va., has been appointed distributors in Virginia.

◆

Lyon - Raymond Corporation.—*George G. Raymond, Jr.*, has been appointed sales manager of the Ryon-Raymond Corporation, and *William L. Peck* assistant sales manager.

◆

Eutectic Welding Alloys Corporation.—*Theodore I. Leston*, formerly director of production of the Eutectic Welding Alloys Corporation, has been appointed vice-president in charge of production, with headquarters at the new plant, 110 Duane street, New York.

◆

Air Reduction Company.—*Charles S. Munson*, formerly president of the Air Reduction Company, has been elected chairman of the executive committee. *John A. Hill*, formerly a vice-president, has been

Charles S. Munson

elected president to succeed Mr. Munson, and *William C. Keeley*, also a former vice-president, has been elected chairman of the newly created finance committee. Mr. Munson began his career with Air Reduction in 1919 and has been president since

John A. Hill

1937. Mr. Hill joined the company in 1939, became secretary in 1941 and a vice-president in 1945.

G. V. Slottman, formerly manager of the technical sales division, has been appointed technical assistant to the vice-president, *Scott D. Baumer*, formerly assistant manager of the division, as manager, and *Edward H. Roper* as assistant manager.

◆

Timken Roller Bearing Company.—*Elmer Anderson*, formerly assistant service manager of the Timken Roller Bearing Company, has been appointed service manager to succeed *Pardee H. Frank*, who has retired after 27 years of continuous service.

◆

Bowser, Inc.—Bowser, Inc., Fort Wayne, Ind., has purchased the entire liquid processing division of the *Buckeye Laboratories* Corporation of Cleveland, Ohio, it has been announced. *Robert H. Webster*, former general manager of Buckeye Laboratories, has joined Bowser as sales manager of the new division.

◆

Link-Belt Company.—The Link-Belt Company has removed its Pittsburgh, Pa., district sales office to 5020 Centre avenue, with *Otto W. Werner*, district sales manager, in charge.

H. Merrill Bowman, district sales manager of the Link-Belt Company at Baltimore, Md., has been appointed assistant divisional sales manager for power transmission equipment, with headquarters at the company's Pershing Road plant in Chicago. Mr. Bowman is succeeded by *Eugene S. Bogart*, who has been transferred from Pittsburgh (Pa.).

◆

Reynolds Metals Company.—A 16 mm motion picture, "Pigs and Progress," has been released by the Reynolds Metals Company, Louisville 1, Ky. The picture, in sound and color, shows the various stages involved in producing aluminum and gives a non-technical insight into the many processes through which buxite goes before emerging as metallic aluminum. It is

available without charge to interested groups through the company's advertising department at 2000 South Ninth street, Louisville.

◆

Norma-Hoffman Bearings Corporation.—*Charles Pomeroy Collins* has been elected president and a director of the Norma-Hoffman Bearings Corporation and will resign his present duties as secretary and general counsel of SKF Industries, Philadelphia, Pa.

◆

Griffin Wheel Company.—*Frederick K. Vial,* vice-president and a director of the Griffin Wheel Company at Chicago, has retired after 45 years of service with the company.

◆

Ransome Machinery Company.—*W. H. Scherer,* who has been appointed general manager and elected a director of the Ransome Machinery Company, a subsidiary of the Worthington Pump & Machinery Corp., as announced in the February issue, was assistant superintendent of the East Springfield, Mass., works of the Westinghouse Electric Corporation for 20 years. He joined Worthington Pump & Machinery in 1937 as superintendent of the Holyoke, Mass., works, and was later appointed assistant to the vice-president in charge of manufacturing. He has been acting manager of Ransome Machinery since June, 1947.

W. H. Scherer

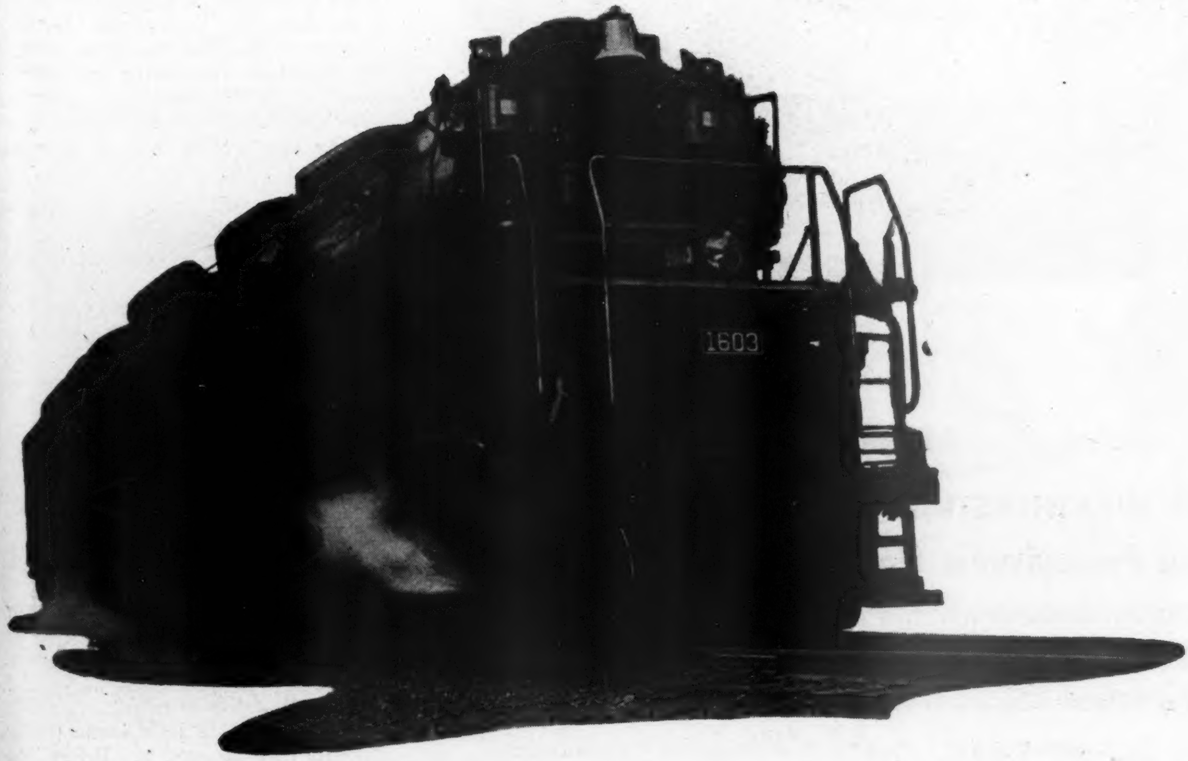
◆

Magnaflux Corporation.—A second National Conference on Railroad Inspection with Magnaflux and Zyglo will be held by the Magnaflux Corporation on April 12 and 13 at the Congress Hotel, Chicago. Individual and panel groups of railroad men will read papers on and discuss practices and recommendations for most effective Magnaflux and Zyglo procedures used by suppliers during manufacture and by the railroads for inspection of Diesel and steam locomotives, car parts, track materials, maintenance-of-way equipment, and for reclamation.

◆

Bear Manufacturing Company.—*Edward Quekels,* sales manager of the Bear Manufacturing Company for the last 15 years, has been appointed director of a newly created product development and service department. *Walter V. Hall,* who

there is a place . . .



WE FIRMLY believe that for a long long time, there will continue to be a demand for steam locomotives.

Therefore, while we *are* building diesel-electrics for the switching field — and while we *have* the highest hopes for the free-piston gas generator turbine which we are now testing for locomotive use—we will continue to build a complete line of steam locomotives.

We will continue to explore all possible ways of improving such locomotives. We will continue to build them with the traditional fineness of design and manufacture that is responsible for Lima's world-wide reputation. And we will continue to believe that there is a place for these locomotives — for such modern power as the 2-6-6-6's we are now building, as our fifth order for the C&O.

LIMA
HAMILTON
CORPORATION

DIVISIONS: *Lima, Ohio* — Lima Locomotive Works Division; Lima Shovel and Crane Division. *Hamilton, Ohio* — Hooven, Owens, Rentschler Co.; Niles Tool Works Co.

PRINCIPAL PRODUCTS: Locomotives; Cranes and shovels; Niles heavy machine tools; Hamilton diesel and steam engines; Hamilton heavy metal stamping presses; Hamilton-Kruse automatic can-making machinery; Special heavy machinery; Heavy iron castings; Weldments.

joined the company as a market specialist a year ago, will take over sales of automotive alinement and industrial balancing equipment.

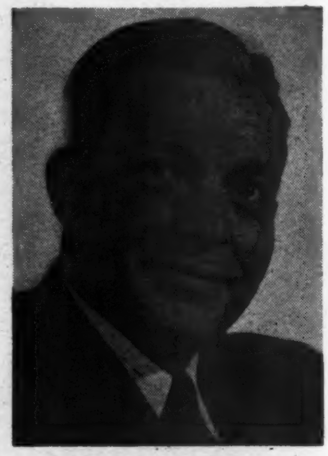
◆

LUMINATOR, INC.—*Orval W. Rahn*, who has been associated with Luminator, Inc., at Chicago, since 1939, has been appointed associate design engineer.

◆

AMERICAN LOCOMOTIVE COMPANY. — *Harry P. Davison* has been appointed assistant to William S. Morris, vice-president of the American Locomotive Company.

Harry P. Davison has been associated with American Locomotive since 1919. He started at the Montreal, Que., plant as a shop clerk and was the first special apprentice ever employed by Alco in its accounting department. He later became a specialist in cost accounting. Before being transferred to the general offices in Schenectady, N. Y., in 1936, he served in company plants at Dunkirk, N. Y., and Auburn, and Richmond, Va.



Harry P. Davison

◆

AIR REDUCTION PACIFIC COMPANY.—The Air Reduction Pacific Company, a subsidiary of the Air Reduction Company recently organized to take over the West Coast business of the Air Reduction Sales Company, has announced the appointments of four vice-presidents, as follows: *L. A. Hamilton* for the Seattle, Wash., district; *E. W. MacCorkle, Jr.*, for the Portland, Ore., district; *H. W. Saunders* for the San Francisco, Calif., district, and *H. A. Hoth* for the Los Angeles, Calif., district.

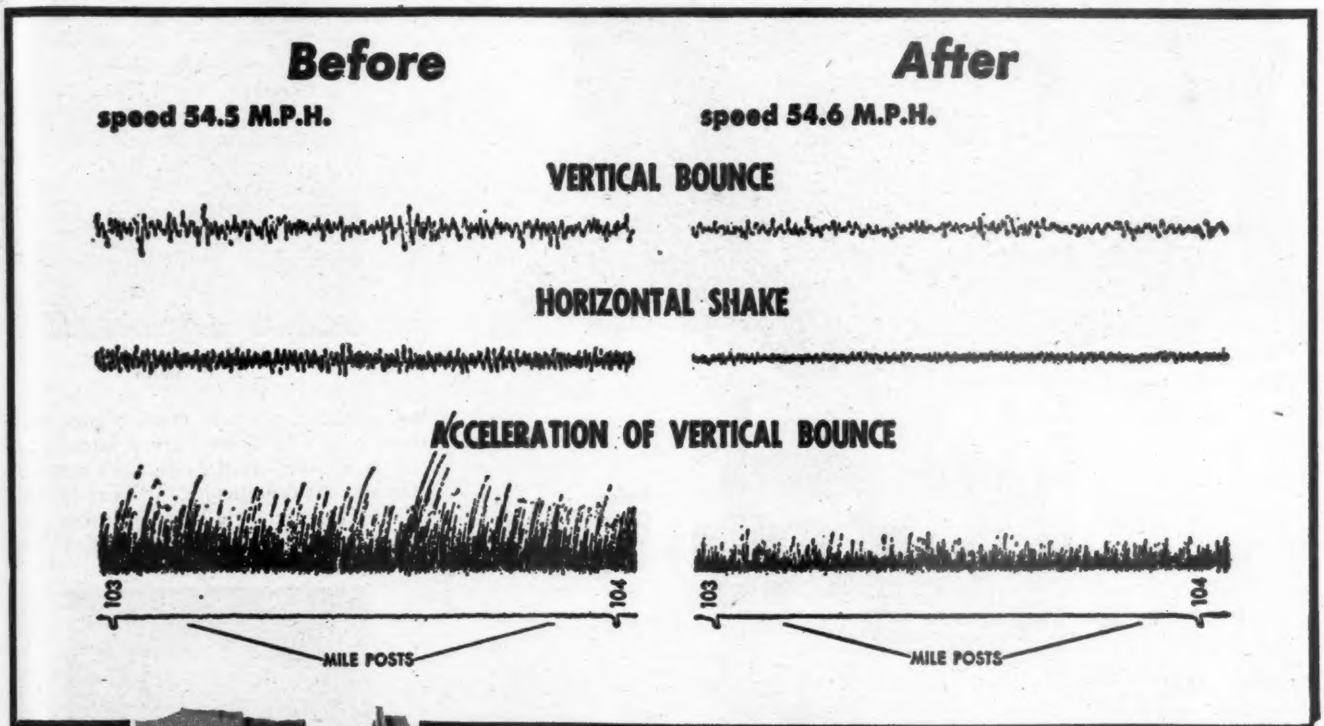
◆

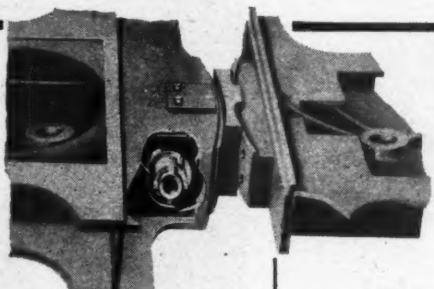
SKF INDUSTRIES, INC.—*E. A. Hutson* has been appointed railway sales field engineer in the Chicago district office of SKF Industries, Inc.

◆

GENERAL MOTORS CORPORATION, FRIGIDAIRE DIVISION.—*J. G. Clarke*, former beverage-cooler contact representative for the direct factory sales department of the Frigidaire division of the General Motors Corporation, has been appointed railway dining car refrigeration and mobile water cooler specialist, to succeed *J. R. Killen*. Mr. Killen has been appointed resident representative for direct factory sales in the Pacific region, with headquarters in San Francisco, Calif., to succeed the late *Russell*

How to cure a ROUGH-RIDING LOCOMOTIVE





FRANKLIN E-2 BUFFERS will reduce maintenance by damping and absorbing horizontal shake and vertical vibration.

The E-2 radial buffer incorporates a built-in draft gear with large bearing areas. Two large adjusting wedges, energized by compressed springs, hold the chafing plates in firm contact, permitting no slack but retaining complete freedom of movement between engine and tender. This effectively dampens and absorbs both horizontal shake and vertical vibration of the locomotive. Only the Franklin "E" type buffers provide this shock absorbing action.

The E-2 radial buffer will make any locomotive, at any speed, a better riding engine. It requires minimum attention and will cut down maintenance on many related locomotive parts by markedly reducing shake and bounce. Crews appreciate the greater comfort it brings.

The above charts show the effectiveness of this buffer. These charts were made on a western road — two days apart — on the same locomotive, between the same mileposts, pulling the same trainload in the same direction at the same speed. The E-2 buffer, as compared with the wedge-type buffer originally used, reduced vertical bounce 50%, horizontal shake 66%, and acceleration of vertical bounce (impact factor) 62%.

FRANKLIN RAILWAY SUPPLY COMPANY

REG. U.S. PAT. OFF.

NEW YORK • CHICAGO • MONTREAL

STEAM DISTRIBUTION SYSTEM • BOOSTER • RADIAL BUFFER • COMPENSATOR AND SNUBBER • POWER REVERSE GEARS
AUTOMATIC FIRE DOORS • DRIVING BOX LUBRICATORS • STEAM GRATE SHAKERS • FLEXIBLE JOINTS • CAR CONNECTION

Longstreth. The company also has announced the appointment of *C. E. P. Smith* as railway refrigeration and air-conditioning specialist, a newly created sales engineering post in direct factory sales.

C. E. P. Smith

J. G. Clarke joined Frigidaire's commercial and air-conditioning division in 1927 as sales engineer. He later worked as zone manager of the New England and New York areas before his wartime assignment in priorities in 1941. He was with Frigidaire's machine gun training unit from 1942 until 1944 when he became associated with direct factory sales. Mr. Smith joined the company in 1936 as an instructor in the Frigidaire service department. He was transferred to direct factory sales in 1945.

J. G. Clarke

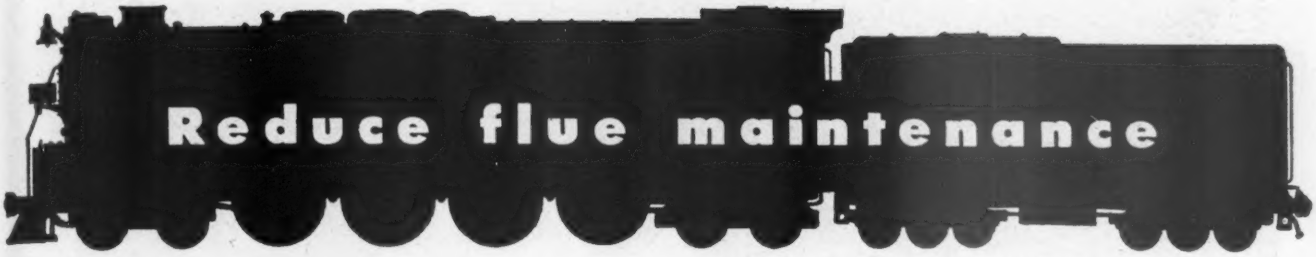
J. R. Killen became associated with Frigidaire's commercial sales department in 1926 and transferred to direct factory sales in 1935.

◆

STANDARD FORGINGS COMPANY.—*C. R. Lewis,* vice-president and a director of the Standard Forgings Corporation at Chicago has retired after 30 years of service with the company. Mr. Lewis' railroad experience included 22 years in the freight traffic department of the Cleveland, Cincinnati, Chicago & St. Louis.

◆

AMERICAN BRAKE SHOE COMPANY.—*John A. Fellows* has been appointed assistant chief metallurgist at the research center of the American Brake Shoe Company



on existing locomotives

From the point of view of saving in flue maintenance, as well as improvement in steaming qualities, the installation of Security Circulators in existing steam locomotives will prove a profitable investment.

Security Circulators are suitably proportioned to the size and type of boiler to give the best results in bettering boiler performance and increasing locomotive availability.

AMERICAN ARCH COMPANY, INC.

NEW YORK • CHICAGO

SECURITY CIRCULATOR DIVISION

at Mahwah, N. J. Mr. Fellows is resuming his association with the company after 2½ years' service in the atomic energy field and 1½ years with the Union Carbon & Carbide Co. He originally joined Brake Shoe as assistant metallurgist in December, 1937.

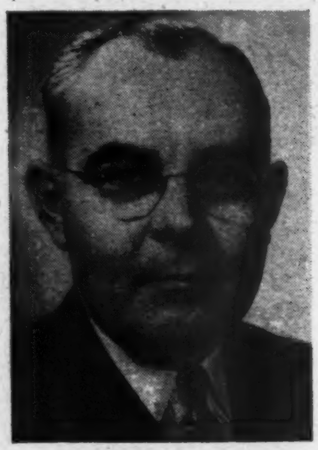
John A. Fellows

J. Robert Pauline, formerly assistant to the vice-president in charge of operations and engineering, has been appointed works manager of the Kellogg division, with headquarters in Rochester, N. Y.

◆

Duff-Norton Manufacturing Company.—*L. E. Lee* has been appointed sales manager of the Duff-Norton Manufacturing Company.

Mr. Lee began his business career with the Goodyear Tire & Rubber Co. In 1933 he joined the Johns-Manville Sales Corporation of New York, as manager of sales promotion and jobber relations and for the past nine years has worked in the transportation department at Cleveland, Ohio.



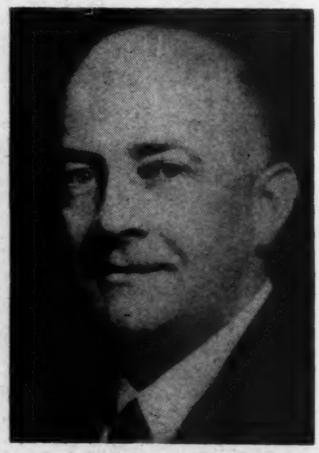
L. E. Lee

◆

Pyle-National Company. — *A. C. Heehler*, formerly with the Mars Signal Light Company of Chicago, has been appointed sales engineer of the Pyle-National Company. *Peter G. Holliday*, formerly vice-president of the Standard Cap & Seal Corp., Chicago, has been appointed works manager, and *Thomas J. Little* eastern sales

manager. Mr. Little's headquarters are in Grand Central Terminal, New York.

Thomas J. Little was previously a member of the sales organization of Anaconda Wire & Cable Co., New York, as sales engineer, manager of transmission sales, and as executive assistant. He was appointed U. S. Delegate to and attended the International Hi-Voltage Congress (C.I.G. R.E.) held in Paris, France, July, 1946. During the war Mr. Little served for two years with the New York Ordnance District as Chief of the Conversion Engineering Section, Production Service Branch, Industrial Division. Upon completion of this assignment he received the U. S. Army Ordnance Award for Meritorious Civilian Service on October 10, 1944. From June 15 to March 1, 1945, he was on duty in



T. J. Little

Germany as Chief of the Non-Ferrous Metal Section of the Office of Military Government. During the first five years of his career Mr. Little was in the mining industry where he worked as sampler, trammer, shift boss, and electrician. The next four years were spent in the study of electrical engineering at Union College and the General Electric Engineering Test Departments at Schenectady, N. Y., and Pittsfield, Mass., specializing in railway electrification and high-voltage work. Upon completion of this training he returned to Anaconda Copper Mining Company and was for five years electrical engineer and electrical superintendent of its Anaconda and Butte properties.

Obituary

William L. Beaudway, president of the Chicago Malleable Castings Company at Chicago, died at his home in that city on January 28.

W. Tom Ashe, sales representative of the Railway Truck Corporation, with headquarters at Chicago, died at Mercy hospital in that city on January 18, following a short illness.

Ray G. Aurien, assistant chief mechanical engineer of the American Steel Foundries at Chicago, died at his home in Evanston, Ill., after an illness of several months. Mr. Aurien had been a member of the firm's engineering staff since 1929,

5 MILLION MILES

OF MOUNTAIN HAULING—

AVAILABILTY 88.4%

If you're looking for day-in and day-out dependability—for maintenance costs that will make even the toughest "super" face life with a smile — then make sure your next freight locomotives bear the General Motors name plate.

Consider, for a moment, the outstanding performance of General Motors Diesel freight locomotives on the Denver & Rio Grande Western—a line that provides a good stiff test of a locomotive's brute strength and stamina.

In rugged service — hauling heavy freight up mountains and braking it down grades. Twelve General Motors freight Diesels show an average availability record of 88.4%. They have covered a total of 5,246,815 miles since 1942 with an average monthly mileage per locomotive of 9,254. Three other General Motors locomotives are amassing similar records in combined freight and passenger service.

Records like these are potent reasons why railroad men everywhere have made General Motors Diesels the synonym for "tops" in the freight-haulage field, as well as in passenger and switching service.

General Motors LOCOMOTIVES

ELECTRO-MOTIVE DIVISION

GENERAL MOTORS — LA GRANGE, ILL.

prior to which time he had served in the engineering department of the American Brake Company at St. Louis, Mo.

◆

William Beck, service engineer in the Southwest and West for the Magnus Brass Manufacturing Company, died suddenly in Cheyenne, Wyo., on January 10.

Personal Mention

Silas J. Fuller, whose appointment as mechanical engineer of the St. Louis Southwestern, at Pine Bluff, Ark., was reported in the February issue, was born on December 25, 1894, at Denison, Tex. He attended elementary and high schools in his home town and received his education in mechanical engineering through the International Correspondence Schools. He began his railroad career in 1911 as a machinist apprentice in the employ of the Missouri, Kansas & Texas (now Missouri-Kansas-Texas), and entered the road's mechanical engineering department as a draftsman at Denison in 1914. Following military service during World War I, Mr. Fuller returned to the M-K-T as a mechanical draftsman at Parsons, Kan., in 1919. Shortly thereafter he entered the service of the Kansas City Southern as mechanical draftsman. In 1922, he became mechanical draftsman of the Cotton Belt. He was appointed general car foreman at Pine Bluff in 1939 and assistant mechanical engineer in 1942.

Silas J. Fuller

E. F. Weber has retired as general superintendent of automotive equipment of the Burlington Lines at Chicago. Mr. Weber was born on November 6, 1877, at Creston, Iowa. He began his career with the Burlington as a boilermaker apprentice at Creston in 1892, at the age of 15. He left the road in 1896 to engage in other pursuits. He completed a course in mechanical engineering with the International Correspondence School and rejoined the Burlington in 1904 as tool room foreman and draftsman at Creston. He was subsequently transferred to the engineering de-

partment at Chicago, where he was assigned to supervise the operation of internal-combustion engines used in the water-service department and to improve the operation and maintenance of section-type motor cars. Mr. Weber was later, successively, special mechanic on the general manager's staff, assistant engineer, superintendent of automotive service, and general superintendent of automotive equipment.

L. B. George, who has been appointed assistant chief of motive power and rolling stock of the Canadian Pacific at Montreal, Que., as announced in the February issue, was born at Ashton-in-Makerfield, England, on April 14, 1896. He entered railroad service on December 5, 1910, as a messenger in the mechanical department of the Canadian Pacific at Vancouver, B. C. He was appointed a clerk in the mechanical department in August, 1911, and machinist apprentice at Vancouver in August, 1913. Mr. George enlisted with the Canadian Expeditionary Forces on September 7, 1915, and served with the 72nd Seaforth Highlanders, 4th Canadian Machine Gun Battalion in England, France and Belgium, and also as draftsman at Wollwich Arsenal. He was wounded in the Battle of the Somme in November, 1916. Mr. George returned to the C. P. R. on July 7, 1919, and served in various capacities in the mechanical department, in September, 1940, becoming division master

L. B. George

mechanic at Lethbridge, Alta. He was loaned to the Canadian government as assistant supervisor aircraft production, Department of Munitions and Supply, at Ottawa, Ont., in July, 1941, and during the following September became supervisor of aircraft production for Canada. In March, 1942, Mr. George became works manager, Weston shops, C. P. R., at Winnipeg, and in May, 1946, assistant superintendent motive power and car department, Western lines, C. P. R., at Winnipeg.

M. P. Nunnally, whose appointment as assistant superintendent of motive power of the St. Louis Southwestern, at Pine Bluff, Ark., was reported in the February issue, was born at Richmond, Va., on March 22, 1898. He began his railroad career as a machinist apprentice with the Southern in 1916. He later became machinist and shop draftsman, and in 1922

GOOD SOLDER, AND ALL THIS TOO!

In Federated solder you get the exact metal you specify, PLUS all these intangible ingredients. These background factors mean service and security...they mean that you get *consistently* better solder to help you do a *consistently* better job.

For any size, form, or composition of solder—bar, pig, body, drop, foil and ingot; acid core, rosin core and solid wire; triangle, strip, wiping and segment — see Federated first.

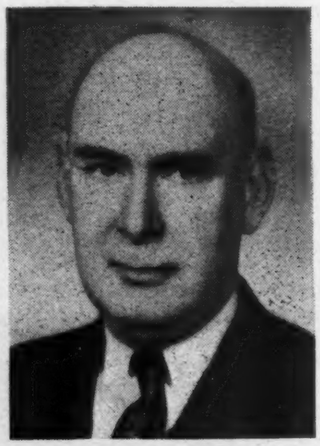
Federated
METALS DIVISION

AMERICAN SMELTING AND REFINING COMPANY
120 BROADWAY, NEW YORK 5, N. Y.

Federated first in the non-ferrous field FMD

F-80

joined the engineering department of the American Locomotive Company. During the following year he was employed in the engineering department of the Clinchfield.



M. P. Nunnally

In 1926, he was appointed chief draftsman of the Cotton Belt; in 1942, acting mechanical engineer and, in 1943, mechanical engineer, and was holding the latter position at the time of his current promotion.

A. H. Glass

A. H. Glass, chief motive power inspector of the Chesapeake & Ohio, has been appointed fuel supervisor, with headquarters in Richmond, Va. In his new position Mr. Glass will draw up specifications for locomotive fuel, supervise the inspection of mines and fuel, oversee the instruction of employees in the use of locomotive fuel, and participate in tests made in connection with locomotive operation and fuel consumption. Mr. Glass began his railroad career as a locomotive fireman in the employ of the Norfolk & Western in 1913. In 1914 he became a fireman on the C. & O. He served with the United States Army in 1917-18, then returned to the C. & O. as a locomotive engineman. He became traveling fireman in 1927; motive-power inspector in 1929; mechanical assistant on May 1, 1942, and chief motive-power inspector in 1943.

Charles A. Nicholson, whose retirement as assistant superintendent of motive power of the St. Louis Southwestern, at Pine Bluff, Ark., was reported in the Feb-

This cheery "Fiesta" car is social center of new trains in Golden State Fleet

ROCK ISLAND'S BEST:

THE COLORFUL GOLDEN STATE FLEET

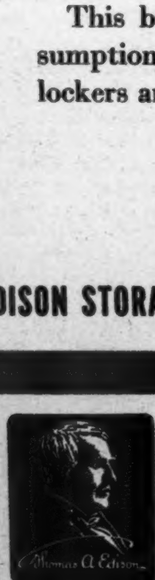
Passenger comfort, safety and satisfaction are given prime consideration in the luxurious postwar passenger cars on the Rock Island's new Golden State Fleet. This is evidenced by the wide use of electric power for improvements in air conditioning, illumination, brake control, radio and wire recording, food-serving facilities and other functions. Cars utilize the 64-volt system, which includes 7½-kw engine-generators and 50-cell A8HW batteries with an 8-hour capacity of 21 kwhr.

The electrical system features an outstanding method of generator regulation, based on the ability of the nickel-iron-alkaline battery to accept current at an average of its normal 7-hour charge rate. Through this method, the battery receives a high rate of charge during low load intervals when the generator has ample output for charging; during heavy load periods it merely floats on the line.

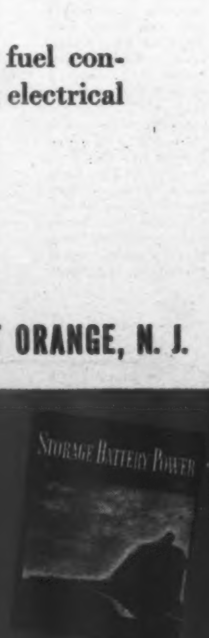
This balanced distribution of generator output reduces materially both fuel consumption and engine wear. In addition, load-voltage regulator losses are lower, electrical lockers are cooler and regulator carbons last longer.

For full details on the Golden State Fleet generator control and the manner in which it obtains maximum performance, contact your EDISON district office.

EDISON STORAGE BATTERY DIVISION OF THOMAS A. EDISON, INCORPORATED, WEST ORANGE, N. J.



EDISON
Nickel • Iron • Alkaline
STORAGE BATTERIES



ruary issue, was born at Litchfield, Ill., on August 1, 1877. He entered railroad service in 1891 as a machinist apprentice in the employ of the Wabash at Moberly, Mo., and subsequently served as shop clerk and car foreman. In 1898 he joined the Fremont, Elkhorn & Missouri Valley (now Chicago & North Western) as a brakeman at Chadron, Neb. He became a carman in 1899, and later chief clerk to the master mechanic of the Kansas City Southern at Shreveport, La. In 1901 he was employed by the Missouri Pacific at St. Louis, Mo., and subsequently advanced to chief clerk to general master mechanic. Mr. Nicholson joined the St. Louis Southwestern in 1917 as chief clerk to the superintendent of motive power at Pine Bluff. In 1923 he was appointed assistant to superintendent of motive power, and in 1943, assistant superintendent of motive power.

William H. McAmis, whose appointment as superintendent of motive power of the Chicago & North Western, at Chicago, was reported in the January issue, was born on January 20, 1902, at Montgomery, Ala. He began his railroad career as an apprentice machinist with the Central of Georgia in 1917. He later served with the

William H. McAmis

Gulf, Mobile & Northern (now Gulf, Mobile & Ohio) and in 1920 entered the employ of the Missouri Pacific, serving as a machinist, successively, at Gurdon, Ark., and as night enginehouse foreman at Newport, Ark., Texarkana, and Poplar Bluff, Mo. He was appointed general foreman at Poplar Bluff in 1943, and in 1944, chief mechanical inspector of the C. & N. W.

W. Frederick A. Benger, who has been appointed assistant chief of motive power and rolling stock of the Canadian Pacific at Montreal, Que., as reported in the February issue, was born at Port Arthur, Ont., on July 29, 1892, and received his B.S. in M.E. degree from Queens University, Kingston, Ont., in 1913. He entered railroad service during the summer of 1911 as a special apprentice in the employ of the Canadian Pacific Angus shops at Montreal and served during the summer of 1912 as special apprentice at the Fort William enginehouse. From May to October, 1913, Mr. Benger was a special apprentice at the Angus shops of the C. P. R. at Montreal, becoming draftsman in the locomotive

drawing office at Montreal on October 1, 1913. From August 8, 1914, to October 12, 1916, Mr. Benger was on loan to the Dominion Arsenal & Imperial Munitions Board on manufacturing and inspection of ammunition. On October 12, 1916, he became acting engineer of tests at Montreal; on May 1, 1918, chief draftsman and assistant engineer at Montreal; on February 15, 1923, assistant mechanical engineer at Montreal; on February 1, 1941, acting chief mechanical engineer at Montreal, and on January 1, 1946, chief mechanical engineer at Montreal.

W. Frederick A. Benger

Master Mechanics and Road Foremen

J. C. DIETRICH has been appointed acting master mechanic of the Missouri Pacific, with headquarters at Coffeyville, Kan.

A. R. SYKES, master mechanic of the Missouri Pacific at Coffeyville, Kan., has been granted a leave of absence because of illness.

E. L. COX, assistant master mechanic of the Central of Georgia at Macon, Ga., retired on January 15, because of ill health. Mr. Cox entered the service of the Central of Georgia as a machinist in the Macon shops on September 13, 1906. In 1908 he became lead man; in 1909, shop inspector; in 1911, erecting shop foreman; in 1920, general foreman, and on July 1, 1923, assistant master mechanic.

HENRY M. MCKAY has been appointed assistant master mechanic of the Central of Georgia at Macon, Ga. Mr. McKay entered the service of the Central of Georgia as an electrician apprentice in January, 1920. Upon the completion of his apprenticeship he served at Macon as an electrician until May, 1925, when he became traveling electrician, with headquarters at Savannah, Ga. In October, 1931, he was transferred as traveling electrician to Macon, and in August, 1937, returned to Savannah as air-conditioning engineer. He became assistant master mechanic at Macon on January 16.

Shop and Enginehouse

JAMES D. DAUGHON, general foreman of the Central of Georgia at Savannah, Ga., has been promoted to the position of general foreman in charge of the Savannah shops. Mr. Daughon became a blacksmith apprentice in the employ of the Central of Georgia at Savannah in September, 1905. Upon the completion of his apprenticeship in January, 1910, he served as a blacksmith at Savannah until September, 1910, when he was transferred to Macon, Ga. He returned to Savannah in September, 1920, as a foreman in the shops and on June 1, 1946, was appointed a general foreman. Mr. Daughon is a member of the Southern and Southwestern Railway Club.

B. B. MILLIKAN, assistant general boiler inspector of the Chicago, Rock Island & Pacific, has been appointed to general boiler inspector, with headquarters as before at Silvis, Ill.

WILLIAM H. MIMS, assistant mechanical engineer of the Central of Georgia at Savannah, Ga., has been promoted to the position of assistant general foreman at Savannah.

Obituary

T. P. GOLDEN, general boiler inspector of the Chicago, Rock Island & Pacific at Silvis, Ill., died recently.

DEAN F. WILLEY, operating vice-president of the New York, New Haven & Hartford at New Haven, Conn., died on January 23 in his 51st year. Mr. Willey was born at Manchester, N. H., on August 5, 1896, and attended Phillips Exeter Academy and Massachusetts Institute of Technology. He entered railroad service in June, 1920, with the New Haven, and served until April, 1923, as assistant engineer, test department, then becoming general material inspector. He was appointed mechanical inspector in October, 1923; foreman mechanical inspector in November, 1923; general foreman, Dover St. enginehouse in July, 1924; assistant to superintendent of shops at Readville, Mass., in September, 1925, and special mechanical assistant in May, 1930. Mr. Willey was appointed mechanical superintendent in January, 1937; general mechanical superintendent in April, 1941; assistant general manager in November, 1944; assistant vice-president at New Haven in June, 1946, and operating vice-president in November, 1946.

Dean F. Willey